CONNECTICUT FLOOD PLAIN MANAGEMENT SERVICES

DAM-BREACH FLOOD ANALYSIS MESSERSCHMIDT AND WRIGHTS POND DAM FALLS RIVER, WESTBROOK AND ESSEX, CONNECTICUT

April 1997

US Army Corps
of Engineers

New England District

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (LEAVE BLANK)

2. REPORT DATE
April 1997

3. REPORT TYPE AND DATES COVERED
Flood Plain Management Services

4. TITLE AND SUBTITLE
Dam-Breach Flood Analysis
Messerschmidt and Wrights Pond Dam
Westbrook, CT

5. FUNDING NUMBERS

6. AUTHOR(S)
US Army Corps of Engineers
New England District

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
US Army Corps of Engineers
New England District
424 Trapelo Road
Waltham, Mass. 02254

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
US Army Corps of Engineers
New England District
424 Trapelo Road
Waltham, Mass. 02254

10. SPONSORING/ MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
FINAL

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (MAXIMUM 200 WORDS)

Messerschmidt and Wrights Pond Dam are located on the Falls River in Westbrook, Ct. These dams are owned by the State of Connecticut. This study was performed to investigate results of hypothetical dam-breaks at the dams for emergency preparedness planning. Dam failure simulations were performed using the Boss Corporation computer model to determine downstream flood levels. The report includes information on pertinent features of the dams, procedures used for analyses, assumed dam-breach conditions, resulting breach discharges, and delineation of downstream flood limits.

14. SUBJECT TERMS
Dam-Breach Analysis, dam failure, flooding, floodplain

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	*Unclassified*	*Unclassified*	

Standard Form 298
(Rev. 2-89)

MESSERSCHMIDT POND AND WRIGHTS POND DAMS
WESTBROOK, CONNECTICUT

DAM-BREACH
FLOOD ANALYSES

PREPARED FOR

STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION
INLAND WATER RESOURCES DIVISION

PREPARED BY

HYDROLOGIC ENGINEERING BRANCH
WATER CONTROL DIVISION
ENGINEERING DIRECTORATE

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DISTRICT

APRIL 1997

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DAM-BREACH FLOOD ANALYSES

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MESSERSCHMIDT POND AND WRIGHTS POND DAMS
DAM-BREACH FLOOD ANALYSES

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MESSERSCHMIDT POND AND WRIGHTS POND DAMS
DAM-BREACH FLOOD ANALYSES

1. PURPOSE

This report presents the findings of dam-breach flood analyses performed for Messerschmidt Pond and Wrights Pond Dams in Westbrook, Connecticut. The report includes sections on pertinent features of the dams, procedures used for the analyses, assumed dam-breach conditions, resulting breach discharges, and delineation of downstream flood limits (inundation mapping). This study was performed to investigate results of hypothetical dam-breaks at Messerschmidt and Wrights Pond Dams for emergency preparedness planning purposes only, and not because of any expected failures at these dams.

This study was conducted by the Corps of Engineers under its Flood Plain Management Services (FPMS) Program, authorized in Section 206 of the Flood Control Act of 1960. The study was completed at the request of the State of Connecticut, Department of Environmental Protection, and was performed by the New England Division.

2. PROCEDURE

Dam failure simulations at the two dams were performed using the Boss Corporation DAMBRK Computer model for Messerschmidt and Wrights Ponds to determine the corresponding downstream flood levels, resulting from hypothetical dam-breaks. Input for the dam-break models consisted of storage characteristics of the reservoirs, selected geometry and duration of breach development, hydraulic inflows, hydraulic roughness coefficients, and selected downstream valley geometry. Based on the input data, the model computes the dam-break outflow hydrograph and routes it downstream. The analysis provides output on attenuation of the flood hydrograph, resulting flood stages, and timing of the flood wave as it progresses downstream. Included in the report is the procedure used for the analysis, assumed dam-break conditions, and resulting downstream flood discharges and stages.

3. DESCRIPTION

a. General. The study extended from Messerschmidt Pond Dam in Westbrook, Connecticut, downstream along the Falls River, through Wrights Pond Dam, to Mill Pond for a total distance of about five miles. Mill Pond dam is located approximately two miles upstream of the Falls River confluence with the Connecticut River. The drainage area contributing to the study reach increases from 4.42 square miles at Messerschmidt Pond Dam to 5.42 square miles at Wrights Pond Dam to 11.3 square miles at Mill Pond Dam. There are many minor tributaries to the Falls River through the study reach (plate 1 shows the study area).

b. Messerschmidt Pond Dam. This dam has a total length of approximately 600 feet and consists of an earthfill dam, a principal spillway, and three auxiliary spillways. The dam has 454 feet of embankment which is arranged in a horseshoe configuration, and impounds 1,180 acre-feet of water at the top of dam. The central and right embankments are approximately 25 feet above streambed of the Falls River, and the left embankment is about 24 feet above streambed. The principal spillway is a 63-foot wide concrete/masonry weir with a crest elevation of 177.65 feet NGVD, and is located between the central and left embankments. The dam has three auxiliary spillways with elevations at 178.5, 179.5, and 179.5 feet NGVD. The nonoverflow sections of the dam are grass covered earth embankments at elevation 182.8 feet NGVD. The structure has a gated sluiceway and gated penstock which are no longer used. Normal pool elevation is maintained at the principal spillway crest elevation. Messerschmidt Dam has been designed to pass the Probable Maximum Flood (PMF) without overtopping. Pertinent data are listed on table 1; and a plan and profile are shown on plate 2.

c. Wrights Pond Dam. This dam consists of a 320-foot long earth embankment with a vertical masonry wall along the downstream face. The embankment is 15 feet high at the spillway end and tapers uniformally to zero at the abutment end. The dam impounds 390 acre-feet of water at top of dam (elevation 132.3 feet NGVD). The spillway is 100 feet long with about one-half at a crest elevation of 126.7 and one-half at 127 feet NGVD. The dam has an emergency overflow section at elevation 129.7 feet NGVD which is 160 feet long and, also, has a vertical masonry wall along the downstream face. The outlet works consist of a single 18-inch pipe through the center of the spillway section. The normal pool elevation is typically at the spillway crest elevation, and the gate is not operated. Wrights Pond Dam has been designed for 1/2 PMF with 0.9 foot of freeboard. Pertinent data are listed on table 2, and a plan and profile of the dam are shown on plate 3.

TABLE 1
PERTINENT DATA
MESSERSCHMIDT POND DAM

Location:	Falls River, Westbrook, CT
Drainage Area:	4.42 square miles (relatively undeveloped rolling wooded terrain)

Physical Characteristics:

Type:	Earth Embankment
Length:	Approximately 600 feet
Height:	Varies, 25 feet maximum
Top Width:	15 feet
Side Slope:	Upstream face 2.5H:1V Downstream face 2H:1V

Impoundment Behind Dam:

Surface Area:	85 acres at spillway crest 110 acres at top of dam
Volume:	700 acre-feet at spillway crest 1,180 acre-feet at top of dam

Elevations:

Top of Dam:	182.8 feet NGVD
3rd Auxiliary Spillway:	179.5 feet NGVD
2nd Auxiliary Spillway:	178.5 feet NGVD
1st Auxiliary Spillway:	179.5 feet NGVD
Principal Spillway Crest:	177.6 feet NGVD
Streambed:	158.0 feet NGVD

Spillway:

	Length	Type
Principal:	63 feet	broad crested masonry
1st Aux.:	165 feet	earthen weir w/ stone
2nd Aux.:	72 feet	1 ft wide conc. sill
3rd Aux.:	56 feet	concrete slab (adjacent to main spillway)

Capacity at Top of Dam: 8,925 cfs

Outlet Works:

The structure has a gated sluice way and a gated 36-inch diameter cast iron penstock which is no longer used.

TABLE 2
PERTINENT DATA
WRIGHTS POND DAM

Location:	Falls River, Westbrook, CT
Drainage Area:	5.42 square miles (relatively undeveloped rolling wooded terrain)

Physical Characteristics:

Type:	Earth Embankment
Length:	Approximately 320 feet
Height:	Varies, 15 feet maximum
Top Width:	10 feet
Side Slope:	Upstream face 2H:1V Downstream face 2H:1V

Impoundment Behind Dam:

Surface Area:	30 acres at spillway crest
Volume:	120 acre-feet at spillway crest 390 acre-feet at top of dam

Elevations:

Top of Dam:	132.3 feet NGVD
Emergency Spillway:	129.7 feet NGVD
Left Spillway:	127.0 feet NGVD
Right Spillway:	126.7 feet NGVD
Streambed:	117 feet NGVD

Spillway:

	Length	Type
Left Spillway:	47 feet	broad crested concrete
Right Spillway:	53 feet	broad crested concrete
Emergency Spillway:	160 feet	earthen weir-vegetated

Capacity at Top of Dam: 5,600 cfs

Outlet Works:

The structure has an 18-inch diameter low level outlet with an intake at elevation 118.5 feet NGVD. It has a capacity of 27 cfs at elevation 129.3 feet NGVD, and normal water level is maintained by flow over the spillway.

d. Downstream Valley. The river channel within the study reach downstream of Messerschmidt and Wrights Pond Dams, flows through Westbrook and Essex, Connecticut. Cross sectional data required for the dam-break model within the study reach was obtained from selected HEC-2 cross sections from the 1986 Flood Insurance Studies for the two towns.

From Messerschmidt Pond to Mill Pond, the Falls River drops about 136 feet in 5.6 miles, for an average slope of about 25 feet per mile. There are six major road crossings over the Falls River within the study reach in addition to two dams. The first earthen dam has been previously breached and is located approximately 0.4 mile downstream of Messerschmidt Pond Dam. The second dam, a small stone and earth structure with a height of about 6 to 7 feet, has no significant storage and is located near the downstream end of the study, approximately one mile upstream from Mill Pond Dam.

4. METHOD OF ANALYSIS

a. General. This section discusses the methods and assumptions used in the dam-break analysis. The magnitude of a flood resulting from a hypothetical dam-breach depends not only on the size of the project but also on the conditions of failure including the initial level of the reservoir, size of the breach, rate of breach formation, as well as hydraulic features and initial flows in the downstream river channel. The State of Connecticut has adopted a criteria for the initial reservoir levels prior to failure. The assumption is that the water surface elevation is at the top of the dam, with the resulting spillway discharge occurring. That discharge together with appropriate discharges from downstream uncontrolled drainage areas is used as the initial flow prior to a dam failure. Three cases of failure were analyzed for this study:

Case 1 - Wrights Pond Dam fails with water surface at top of dam.

Case 2 - Messerschmidt Dam fails with water surface at top of dam, assuming Wrights Pond Dam had failed previously.

Case 3 - Messerschmidt Dam fails with water surface at top of dam, assuming Wrights Pond Dam fails subsequently.

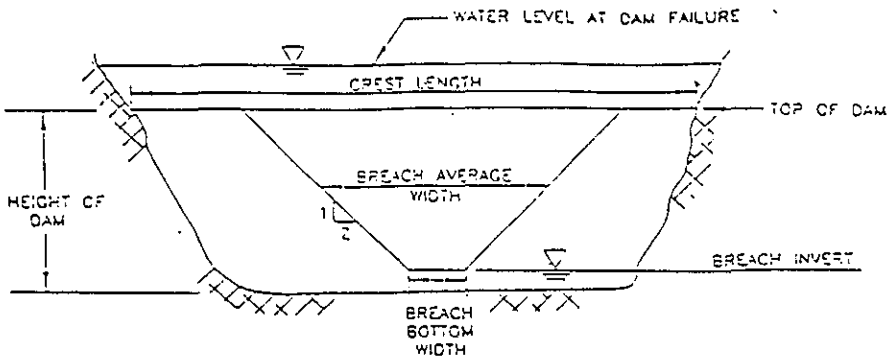
b. Hydrology. Inflow hydrographs were adopted for each dam that would result in peak pool stages reaching the top of the dams (the states criteria for reservoir levels prior to failure). The inflow hydrographs were routed through each reservoir to obtain peak pool stages and outflow flood hydrographs based on the storage and outlet capacities of the dam. Initial reservoir routing was performed using HEC-1 assuming the dam does not breach. In December 1984 the A/E firm of Moffit and Duffy performed Hydrologic and Hydraulic Analysis for the State of Connecticut to determine the adequacy and optimization analysis of alternatives to increase spillway capacities of the two dams. This analysis was the basis for work performed on the two dams to increase their top of dam elevations and spillway capacities.

Messerschmidt Dam was redesigned for a PMF with no freeboard. This design inflow was quickly reviewed for reasonableness and verified to result in a peak pool stage at the top of the dam, based on HEC-1 reservoir storage routings. This was adopted as the inflow hydrograph for the Messerschmidt Pond dam-breach analyses. The adopted design PMF inflow to the dam is shown on plate 4.

Wrights Dam was redesigned for 1/2 PMF with about one foot of freeboard, based on HEC-1 reservoir storage routings. Therefore, the 1/2 PMF inflow would not produce a peak pool at the top of the dam. It was determined that approximately 65 percent of the PMF inflow hydrograph would result in the peak pool stage reaching the top of dam; therefore, this was the adopted inflow hydrograph for Wrights Dam, which is shown on plate 5.

c. <u>Spillway Hydraulic Capacity</u>. Rating curves for the two dams were developed, based on the geometry of the spillway and the dam. Flows through the outlet works (gates and penstocks) were determined to be negligible since these gates reportedly are closed, even during floods. Flows over the spillway, auxiliary spillways, and over top of the dam were determined using the weir equation. This overflow rating curve was used in routing the inflow hydrographs through the reservoir with the HEC-1 model.

d. <u>Assumed Breach Parameters</u>. The discharge hydrograph of a breach is a function of the inflow hydrograph and breach parameters (time of breach formation, size, and shape of breach) of a hypothetical dam failure. The following sketch illustrates the various dam breach parameters for a typical earthen or concrete-gravity dam. Total outflow is a combination of flows through the breach and spillway. As the breach develops, so does the breach discharge.



DEFINITION SKETCH OF BREACH PARAMETERS

Assumed Messerschmidt Pond Dam Failure Condition

Reservoir Inflow: Full PMF

Pool Level at Failure: Top of Dam 182.8 feet NGVD

Breach Invert: 158 feet NGVD

Breach Bottom Width: 125 feet with side slopes 1V:1H

Time to Complete Formation of Breach: 1 hour

Downstream Reach Roughness
(Manning's "n" Values): 0.05 to 0.10

Prebreach Downstream Lateral Inflow: 1/2 PMF hydrographs

Assumed Wrights Pond Dam Failure Condition

Reservoir Inflow: 65 percent PMF

Pool Level at Failure: Top of Dam 132.3 feet NGVD

Breach Invert: 117 feet NGVD

Breach Bottom Width: 85 feet with side slopes 1V:1H

Time to Complete Formation of Breach: 1 hour

Downstream Reach Roughness
(Manning's "n" Values): 0.05 to 0.10

Prebreach Downstream Lateral Inflow: Estimated 500-yr flow hydrographs (from Westbrook and Essex Flood Insurance Study Reports)

A failure without the dam being overtopped is typically the result of piping failure. Piping is internal erosion of the embankment through displacement of fines by seepage. The erosion creates voids in the embankment and, therefore, could lead to breach and eventual collapse of the dam.

A failure can also occur with the dam embankment being overtopped. This overtopping erodes the embankment and, therefore, could cause breach and failure of the dam.

e. Assumed Prebreach Flows. Assumed prebreach flows on the Falls River for dam failure simulations were developed for the downstream watershed. These are the assumed flows from antecedent conditions that would be expected to occur with or without a dam failure. Based on hydrologic conditions of the downstream watershed, lateral inflows, representing contributing flow from downstream tributaries and local runoff areas, were included at river miles 0.897, 3.502, and 4.695 (stationing is in river miles downstream of Messerschmidt Pond). The contributing net drainage area at river mile 0.897 is one square mile. The contributing net drainage areas at river miles 3.502 and 4.695 were 3.29 and 2.59 square miles, respectively. Other dams located on downstream tributaries (i.e. Bushy Hill Dam) were assumed not to fail coincidentally with Messerschmidt and Wrights dam breaches.

(1) Messerschmidt Pond Dam. With a PMF inflow to Messerschmidt Dam it was considered reasonable to assume 1/2 PMF lateral inflow from downstream watersheds. Probable maximum flood conditions at this dam would result in about five feet of spillway surcharge, with a resulting peak outflow (just prior to dam failure) of approximately 9,000 cfs. This extremely rare peak discharge was added to assumed lateral inflows at downstream points equal to the 1/2 PMF flows. This is considered reasonable since the probable maximum storm would require centering over Messerschmidt Pond watershed, which would result in downstream drainage areas receiving somewhat less precipitation, however, it is highly likely these watersheds would experience significant rainfall amounts.

(2) Wrights Pond Dam. With a 65 percent PMF inflow to Wrights Dam, 500-year lateral inflows from the downstream watershed were adopted. With the adopted prebreach conditions for both dams, due to uncontrolled spillway discharges and downstream inflows associated with these rare events, downstream channel capacities would have been exceeded and flooding would have occurred prior to a dam-breach.

f. Downstream Channel Routing. A downstream channel routing analysis allows the breach discharge and hydrograph to be characterized at points of interest below the dams.

The downstream channel stationing adopted is in river miles below Messerschmidt Pond Dam, with river mile 0.0 at the dam. A breach hydrograph is attenuated and stored through the downstream channel and flood plain in a manner similar to that where an inflow hydrograph is routed through a reservoir. The degree to which this breach discharge is attenuated is a function of the downstream valley storage capacity and valley roughness characteristics.

The dynamic wave method of channel routing is used in the NWS DAMBRK computer program to route the flood wave downstream. This is a hydraulic routing method that solves the complete unsteady flow equations through a given reach. Results of this method indicate attenuation of the flood wave, resulting flood stages, and the time it takes the wave to reach the section.

Downstream valley data were determined by obtaining selected cross sections from HEC-2 input files from Westbrook and Essex Flood Insurance Studies. On the average, approximately five cross sections per mile were used to represent the downstream valley. Manning's "n" values were assigned to the channel and overbanks on the basis of the HEC-2 analysis and field observations. Discharge and stage hydrographs at six selected downstream stations (river miles 0.0, 0.642, 1.248, 2.963, 3.912, and 4.833). The locations of these six cross sections are shown on plates 6 and 7. These six were selected to characterize the movement and attenuation of the dam-breach flood wave as it progresses downstream.

The geometry input to define the downstream channel does not include detailed bridge information. This study does not attempt to determine if any downstream structures will or will not fail during a dam-break at Wrights or Messerschmidt Dams. If structures remain intact the peak water surface elevation behind them could increase to stages higher than estimated. However, considering the effects of the high breach flows, most structures would be significantly overtopped, therefore, backwater effects are expected to be minimal at these structures.

5. RESULTS OF ANALYSIS

a. General. This section discusses results of the dam failure analyses at Wrights and Messerschmidt Pond Dams. Dam failure analyses were performed for Wrights Pond and two cases at Messerschmidt Pond, as previously discussed in paragraph 4a. For the failure analyses at Messerschmidt Dam, this report presents results of the case which resulted in higher flood levels.

The results presented for Messerschmidt Dam failure, assume Wrights Dam fails subsequently as a result of the upstream Messerschmidt failure. Wrights Pond Dam has been redesigned for 1/2 PMF plus about one foot of freeboard. With a full PMF outflow, before failure at Messerschmidt, Wrights Pond Dam would be overtopped by only 1.3 feet, and could remain intact until failure flows from the upstream dam are experienced. This case is considered reasonable with the recent design upgrade and work at Wrights Pond Dam. An analysis was also performed assuming Wrights Dam had failed before the upstream dam-breach, due to the lower design level of Wrights. A discussion of this is presented later in the report; however, plots and tables of the results for this case were left out to avoid confusion.

b. Inflow Hydrograph. The peak inflow to Messerschmidt Pond Dam resulting from a PMF storm event was 9,100 cfs. It should be noted that this is an extremely rare event resulting from 20 inches of rainfall in 24 hours. The peak inflow to Wrights Pond Dam resulting from 65 percent PMF storm event was 5,820 cfs. As a reference to the magnitude of these events, the 100-year peak flow used in the Flood Insurance Study was in the order of 1,000 cfs, at the two dams. Plate 4 shows the adopted inflow hydrograph for Messerschmidt, and plate 5 shows the adopted inflow hydrograph for Wrights. These hydrographs were adopted from the 1984 Moffit and Duffy analysis using the HEC-1 computer program.

c. Reservoir Storage Capacity. Storage volumes for the two reservoirs were obtained from the 1984 Moffit and Duffy Hydrologic and Hydraulic Analysis which are in agreement with the curves presented in the Phase I Inspection Reports for the two dams.

d. Spillway Hydraulic Capacity. Maximum hydraulic capacity of the spillway at the top of Messerschmidt Pond Dam is approximately 8,900 cfs, which includes flow over the main and auxiliary spillways. Wrights Pond Dam has a maximum spillway capacity at the top of dam of 5,600 cfs. Messerschmidt Dam appears to have sufficient spillway capacity and adequate storage to pass the PMF storm event without overtopping the dam, whereas, Wrights appears to have the capacity to pass approximately 65 percent of the PMF storm event without overtopping. Peak discharges without dam failure for Messerschmidt and Wrights are 8,925 and 5,600 cfs, respectively.

e. Breach Discharge Hydrograph. Tables 3 and 4 summarize the peak discharge and downstream channel routing results at selected cross sections, for Wrights and Messerschmidt Pond Dams, respectively.

TABLE 3
WRIGHTS POND DAM FAILURE
DOWNSTREAM CHANNEL ROUTING RESULTS

DAM-BREACH

Downstream Location (River Miles)	Peak Discharge (cfs)*	Peak Elevation (ft NGVD)	Time to Peak Elevation (hours)**	Prebreach Flow Elevation	Increase in Depth of Flow (feet)
Messerschmidt Pond Dam (0.0 mi.)					
0.046					
0.196					
0.378					
0.642					
Wrights Pond Dam (1.248)	9,140	132.3	0	132.3	0
1.259	9,140	128.7	0.5	127.3	1.4
1.369	8,885	127.2	0.5	126.3	0.9
Pond Hill Road (1.619)	8,575	122.3	0.6	121.7	0.6
2.545	7,686	104.5	1.3	102.9	1.6
E Pond Meadow Road (2.963)	7,660	86.7	1.4	85.6	1.1
Mares Hill Road (3.681)	7,845	81.1	1.8	80.6	0.5
3.912	7,830	76.8	1.8	76.3	0.5
Main Street (4.378)	7,800	57.5	1.9	57.4	0.1
4.520	7,795	49.8	1.9	49.5	0.3
Mill Pond (4.833)	8,110	42.7	2.1	42.7	0.0

Note: Prebreach flow elevations given are for the prebreach flow without the dams failing.

* Includes inflow from downstream watersheds
** Time to peak measured from start of breach at Wrights Pond Dam

TABLE 4
MESSERSCHMIDT POND DAM FAILURE
DOWNSTREAM CHANNEL ROUTING RESULTS

DAM-BREACH

Downstream Location (River Miles)	Peak Discharge (cfs)*	Peak Elevation (ft NGVD)	Time to Peak Elevation (hours)**	Prebreach Flow Elevation	Increase in Depth of Flow (feet)
Messerschmidt Pond Dam (0.0 mi.)	21,915	182.8	0	182.8	0
0.046	21,915	170.1	0.8	164.4	5.7
0.196	21,850	161.6	0.8	158.2	3.4
0.378	21,750	156.7	0.9	153.7	3.0
0.642	21,410	139.0	1.0	135.4	3.6
Wrights Pond Dam (1.248)	22,115	136.3	1.0	133.6	2.7
1.259	22,115	131.8	1.4	129.3	2.5
1.369	22,000	128.9	1.4	127.5	1.4
Pond Hill Road (1.619)	21,775	123.5	1.5	122.2	1.3
2.545	19,810	111.0	2.0	106.0	5.0
E Pond Meadow Road (2.963)	19,775	90.5	2.2	87.4	3.1
Mares Hill Road (3.681)	20,855	87.6	2.3	84.6	3.0
3.912	20,865	81.9	2.3	79.5	2.4
Main Street (4.378)	20,800	60.6	2.4	59.2	1.4
4.520	20,780	52.6	2.4	51.0	1.6
Mill Pond (4.833)	21,460	47.8	2.6	45.7	2.1

Note: Prebreach flow elevations given are for the prebreach flow without the dams failing.

* Includes inflow from downstream watersheds
** Time to peak measured from start of breach at Messerschmidt Pond Dam

(1) <u>Wrights Pond</u>. A failure at Wrights Pond Dam resulted in a peak breach discharge of approximately 9,150 cfs. The assumed water surface was at the top of the dam, elevation 132.3 feet NGVD when failure began, and the breach was modeled to develop fully within one hour. Plates 8, 9, and 10 show the prebreach and dam-breach flood profiles for the study area; plates 11 and 12 show the breach discharge over a period of time and breach flow depth over time for selected cross sections throughout the reach. Plate 13 shows how the breach flood peak discharge varies with distance downstream.

(2) <u>Messerschmidt Pond</u>. A failure at Messerschmidt Dam resulted in a peak breach discharge of approximately 21,900 cfs. The water surface was at the top of the dam, elevation 182.8 feet NGVD when failure began, and the breach was modeled to develop fully within one hour. Plates 8, 9, and 10 show the prebreach and dam-breach flood profiles for the study area; plates 14 and 15 show the breach discharge over a period of time and breach flow depth over a period of time for selected cross sections throughout the reach. Plate 16 shows how the breach flood peak discharge varies with distance downstream.

6. DOWNSTREAM CHANNEL ROUTING

Plates 8, 9, and 10 show peak water surface profiles resulting from the prebreach initial flow and failures at both Wrights and Messerschmidt Pond Dams.

a. <u>Wrights Pond Dam Failure Results</u>. The peak dam breach discharge computed by the DAMBRK computer program is 9,150 cfs. This flow results in a stage increase of only about 1.5 feet over the prebreach high flow just downstream of the dam. There is very little attenuation as the flood wave is routed downstream due to the high prebreach flow associated with the uncontrolled spillway discharge and downstream watershed inflows. The peak breach discharge attenuates to about 7,700 cfs at river mile 2.545 (about 1.3 miles downstream of Wrights). At river mile 3.681, the peak discharge would be about 7,845 cfs; however, about 4,950 cfs would be the prefailure high flow, with about 2,900 cfs the dam failure flow contribution. Peak stages would only be about 0.5 foot above the assumed prebreach high flows. At areas below this point, the dam-breach flood would generally cause less than a 0.5-foot rise in stages over prebreach stages.

b. <u>Messerschmidt Pond Dam Failure Results</u>. The resulting peak breach discharge from failure at Messerschmidt is 21,900 cfs. The breach results in flood levels approximately six feet higher than prebreach high flow conditions just downstream of the dam. There is very little attenuation between Messerschmidt and Wrights Pond dams. The breach flow at river mile 0.642 is about three feet higher than the prebreach flow. The breach flow would overtop Wrights Pond Dam by approximately four feet. The analysis considers Wrights Dam failing as a result of the Messerschmidt failure. With a subsequent failure at Wrights Dam, the peak breach flow at Wrights would increase to 22,100 cfs. Again there is very little attenuation of the breach discharge, having only attenuated to only 19,800 at river mile 2.454.

It should be noted that although the dam-breach flood shows little increase over the assumed prebreach flood levels, it is an indication of the flooding that can be expected as a result of a dambreak. It is again noted, that the assumed prebreach flood conditions are extremely rare conditions, and there would be considerable flooding prior to failure. These prebreach high flows are due to uncontrolled spillway discharges at the dams, along with downstream lateral inflows and not attributable to dam failures.

Similar to the Wrights Dam failure model, there is little attenuation through the reach. At river mile 3.681 the peak discharge would be about 20,850 cfs; however, about 6,200 cfs would be the prefailure high flow, with about 14,650 cfs the dam failure flow contribution. Peak stages would be about 3.0 feet above the assumed prebreach high floodflow. At river mile 4.378, the dam-breach flood would be about 1.4 feet above the prebreach flow.

c. Downstream Boundary. The dam-breach flood computer analysis was terminated at Mill Pond. The Mill Pond Dam is located 5.626 river miles downstream of Messerschmidt Pond. It is a run-of-the-river type dam with a 68-foot long spillway at a crest elevation of 35.0 feet NGVD. The right embankment is composed of a controlled overtopping section at top of the dam. It is 101 feet in length and has a top elevation of 38.3 feet NGVD. The prebreach high flows would significantly overtop Mill Pond Dam even without upstream dam failures.

In the event of a major dam-break at Messerschmidt or Wrights Pond dams under full pool conditions, the dam could be seriously damaged or fail. The intent of this study is not to determine if, or when, Mill Pond Dam would fail. The adopted dam-breach conditions assume that this dam remains; however, as a sensitivity test, it was assumed that Mill Pond Dam was breached. Even with a failure at Mill Pond Dam prior to Wright's and Messerschmidt's peak failure flows arriving, the actual peak pool at Mill Pond could rise above the spillway crest elevation until the failure occurred. The water level could get several feet above top of the dam before it fails; therefore, the worst case scenario (assuming Mill Pond Dam does not fail) was used in the final results presented in the tables and various plots to get an indication of the potential levels and inundation that could occur.

7. INUNDATION MAPPING

The limits of inundation were computed by routing the breach discharge hydrograph through the downstream valley cross sections and delineating the resulting maximum stages on the base map. The base map used is based on an enlarged 10-foot contour interval 1:24,000 scale USGS quadrangle and, therefore, inundation limits shown on plates 6 and 7 are only approximate. Locations of the six selected downstream stations (river miles 0.0, 0.642, 1.248, 2.963, 3.912, and 4.833) are graphically illustrated on plates 6 and 7. Although any structures shown within these limits were assumed to be inundated, certain structures may be excluded as a result of local conditions and elevations.

8. DISCUSSION

The dam-break analyses for Messerschmidt and Wrights Pond Dams were based on engineering application of certain laws of physics, considering the physical characteristics of the project and downstream channel and conditions of failure. Due to the highly unpredictable nature of a dam-break and the ensuing sequence of events, the results of this study should not be viewed as exact but only as an approximate quantification of the dam-break flood potential. For purposes of analysis, downstream conditions are assumed to remain constant, and no allowance is made for possible enlargement or relocation of the river channel due to scour or the temporary damming effect, all of which could affect, to some extent, the resulting magnitude and timing of flooding downstream.

The results of a dam failure, at either dam, could be catastrophic at areas downstream of the dam. However, for the adopted prebreach flows, due to uncontrolled spillway discharges and downstream inflows associated with these rare events, channel capacities would have been exceeded and flooding would have occurred prior to a dam-breach at the two dams. As noted above, for dam-breaks at the two dams, there is minimal attenuation in peak flows downstream of the dam due to the high prebreach flows and downstream watershed lateral inflows and limited available flood plain storage.

Due to the extremely high and rare adopted prebreach flows, the resulting dam-breach floods show little increase over the prebreach flood levels. It should be noted that a dam failure occurring during a more frequent (less severe) event would result in a more prominent rise over prebreach flood levels. However, the peak breach levels and flooded areas would be less than the adopted results.

The results presented for Messerschmidt Pond Dam failure, assume Wrights Pond Dam fails subsequently as a result of the upstream Messerschmidt failure. Analysis was also performed assuming Wrights Dam had failed before the upstream dam-breach, due to the lower design level of the Wrights spillway. This analysis resulted in breach flood levels generally within one foot of the adopted breach conditions. In general, the storage behind Wrights Pond is not that significant when added to prebreach flows and failure flows at Messerschmidt Dam, therefore, resulting in only a slight increase in flow and stage due to the additional volume of water at Wrights Pond.

The dambreak analyses ended at Mill Pond, which is located about five miles downstream of Messerschmidt Pond. The State of Connecticut's criteria for ending dam breach analyses, is to compute the water surface elevations downstream of the dams until the breach water surface elevations are within 1.5 feet of the prebreach water surface elevations. Wrights dam failure flows are within 1.5 feet, approximately 1.5 miles downstream of Wrights Pond (about halfway between Wrights and Mill Pond). There is no increase in breach water surface elevation over the prebreach elevation at Mill Pond. Messerschmidt dam failure water surface elevation is within the 1.5-foot criteria at areas upstream of Mill Pond, and within 2.1 feet at Mill Pond because of local hydraulic conditions. Based on these results, it is recommended that no further downstream study is necessary.

The results of dam-break sensitivity analysis, of the major variables used in the model, such as breach width, duration of breach, and breach side slopes, indicate no significant change in results of peak flows in the downstream valley.

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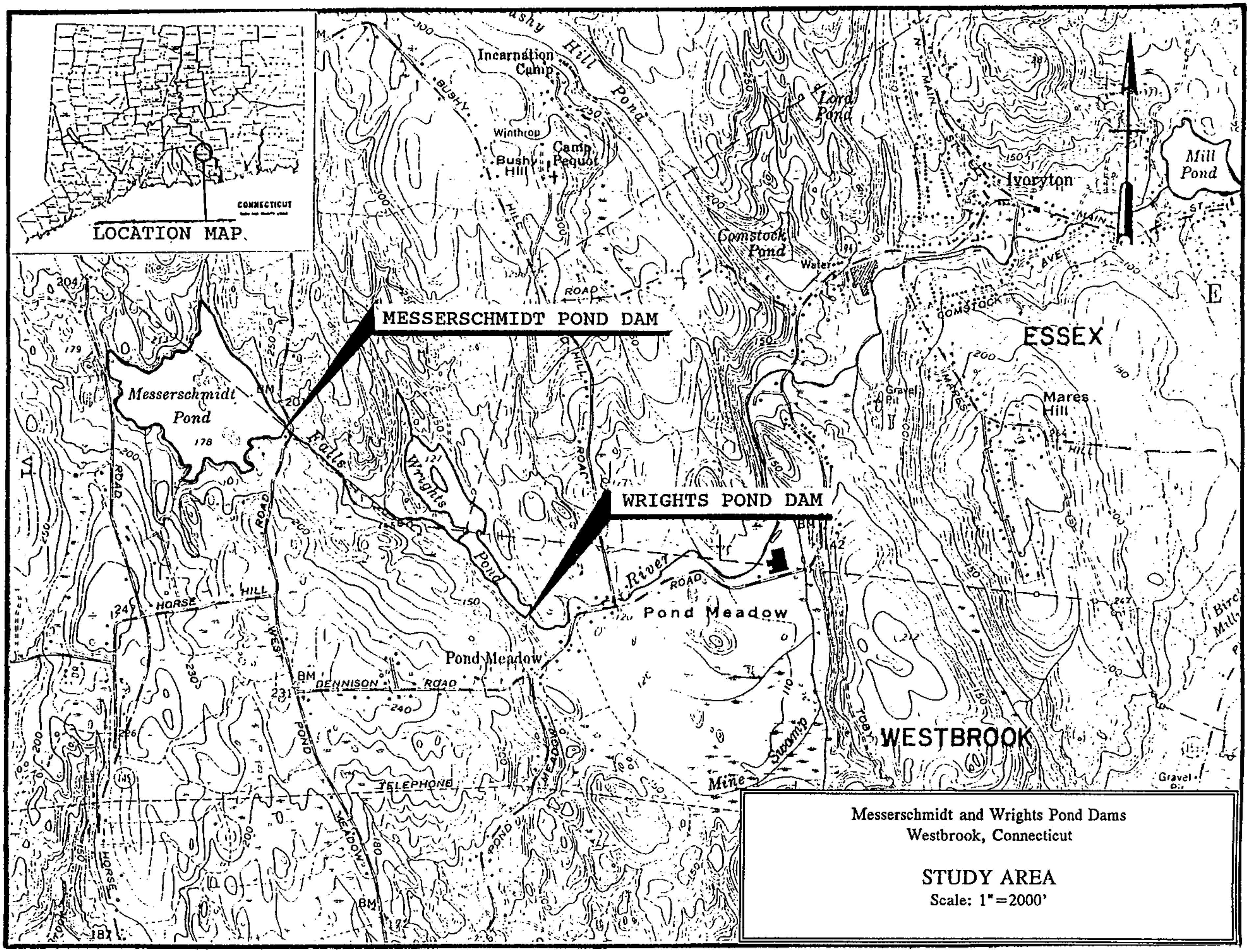
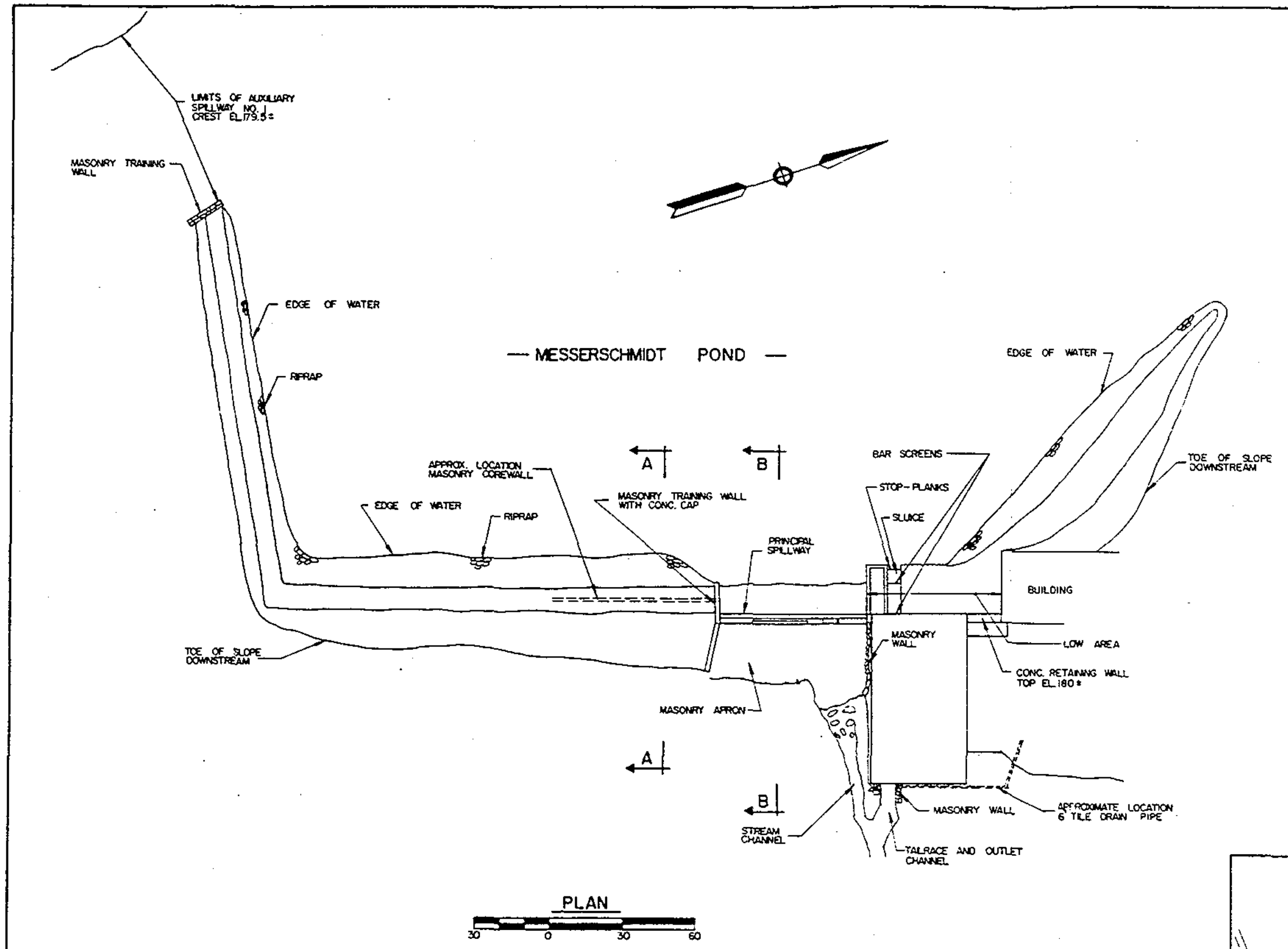
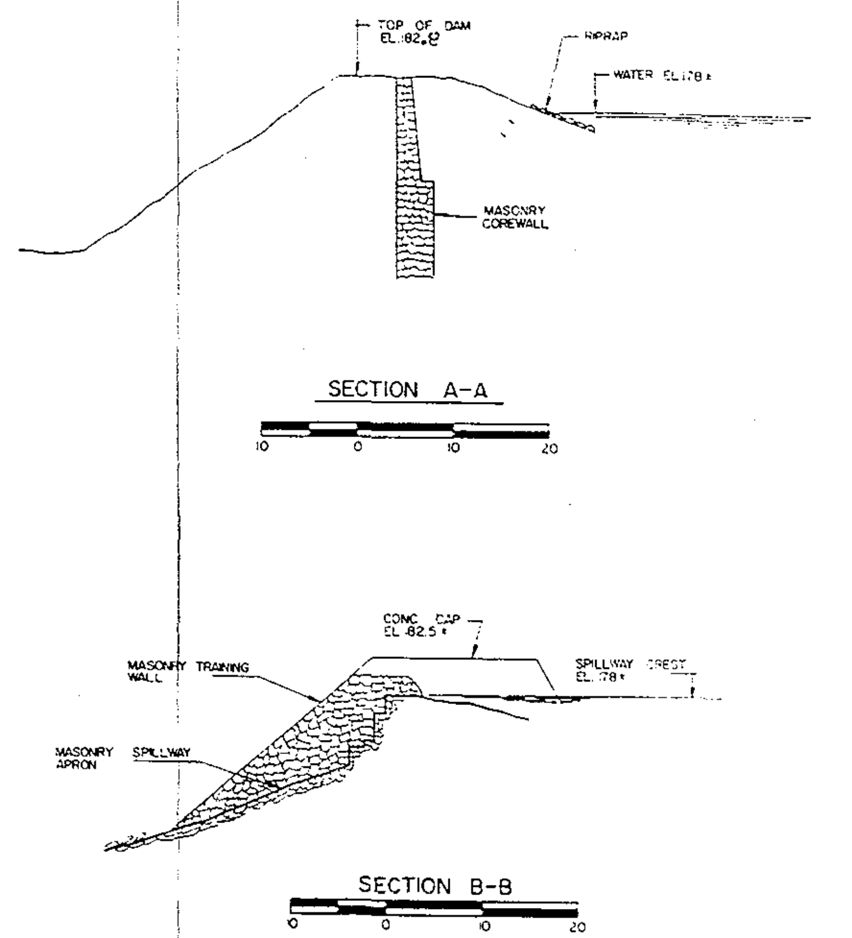


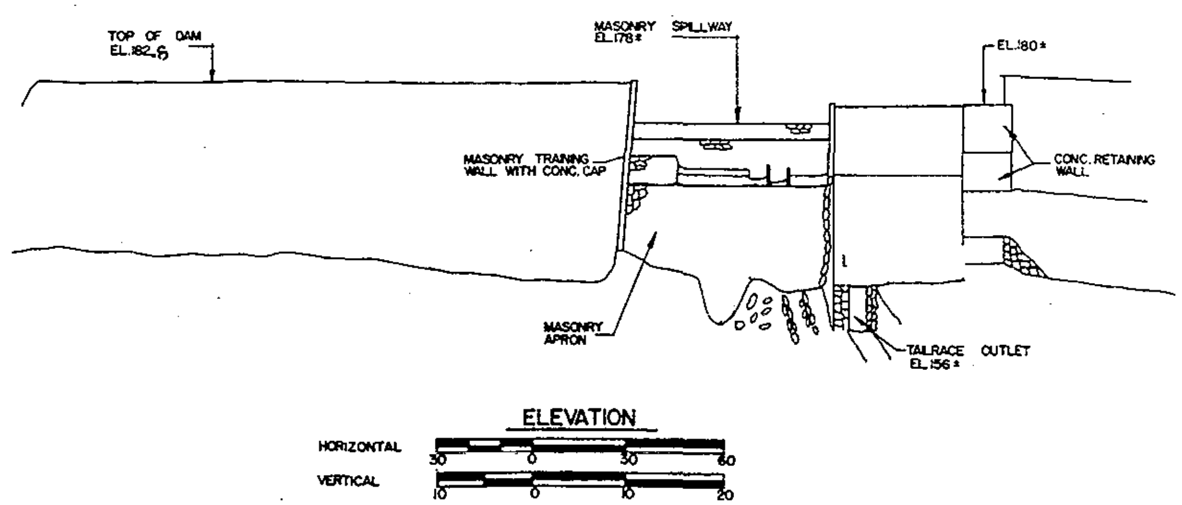
Messerschmidt and Wrights Pond Dams
Westbrook, Connecticut

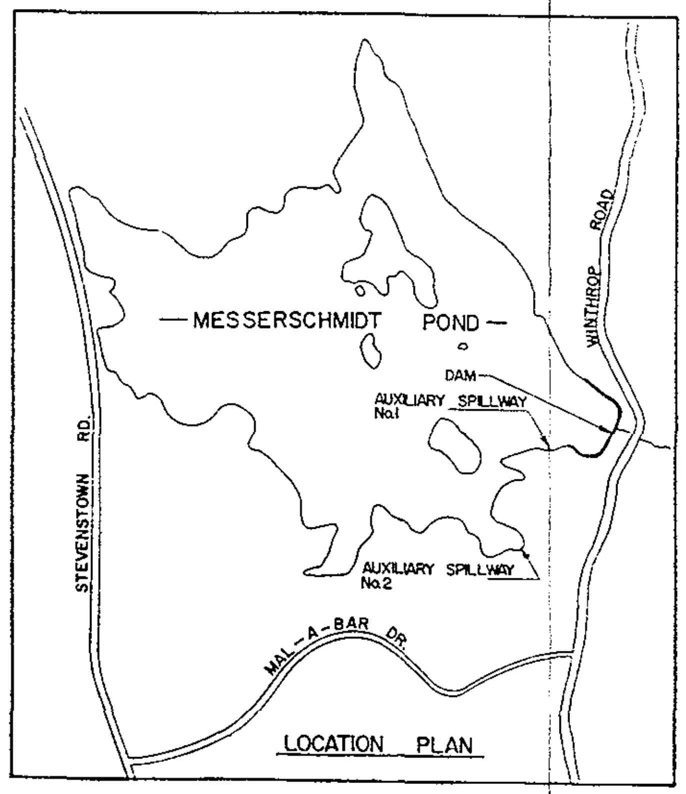
STUDY AREA
Scale: 1"=2000'

PLATE 1









NOTES:

1. THIS PLAN WAS COMPILED FROM AN EXISTING DRAWING "PLAN SHOWING MESSERSCHMIDT DAM" BY J.J KELSEY, NOVEMBER 1939 AND SUPPLEMENTARY SURVEY BY CAHN ENGINEERS, SEPTEMBER 1979. NOT ALL TOPOGRAPHIC AND/OR STRUCTURAL FEATURES ARE NECESSARLY IDENTIFIED.

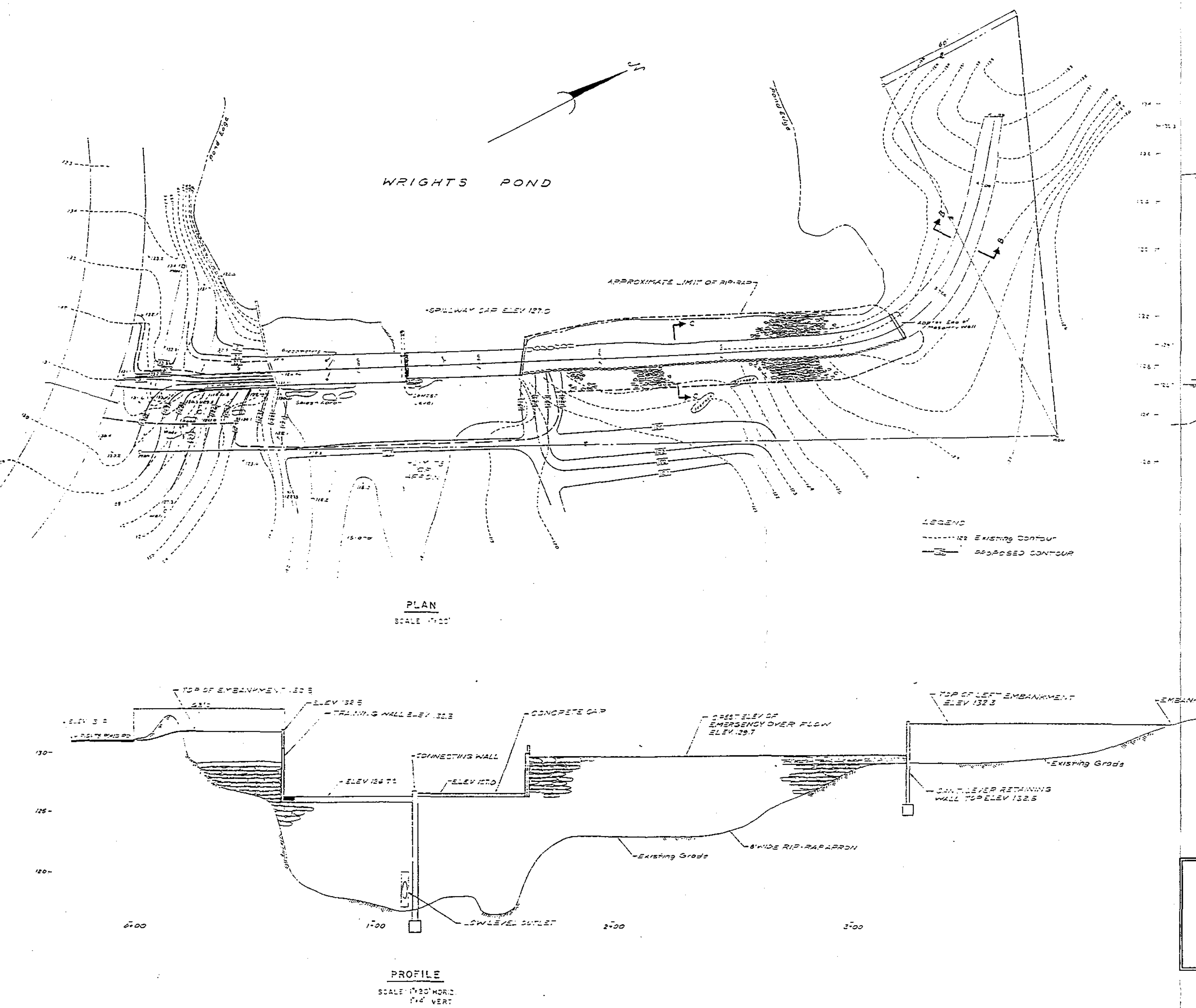
2. NO NGVD. ELEVATIONS WERE AVAILABLE FOR THE DAM. THE WATER SURFACE ELEVATION SHOWN ON THE 1958 (P.R 1970) U.S.G.S ESSEX QUADRANGLE MAP WILL BE ASSUMED EQUIVALENT TO THE SPILLWAY CREST ELEVATION. ALL OTHER ELEVATIONS SHOWN ARE REFERENCED TO THE ASSUMED SPILLWAY CREST ELEVATION

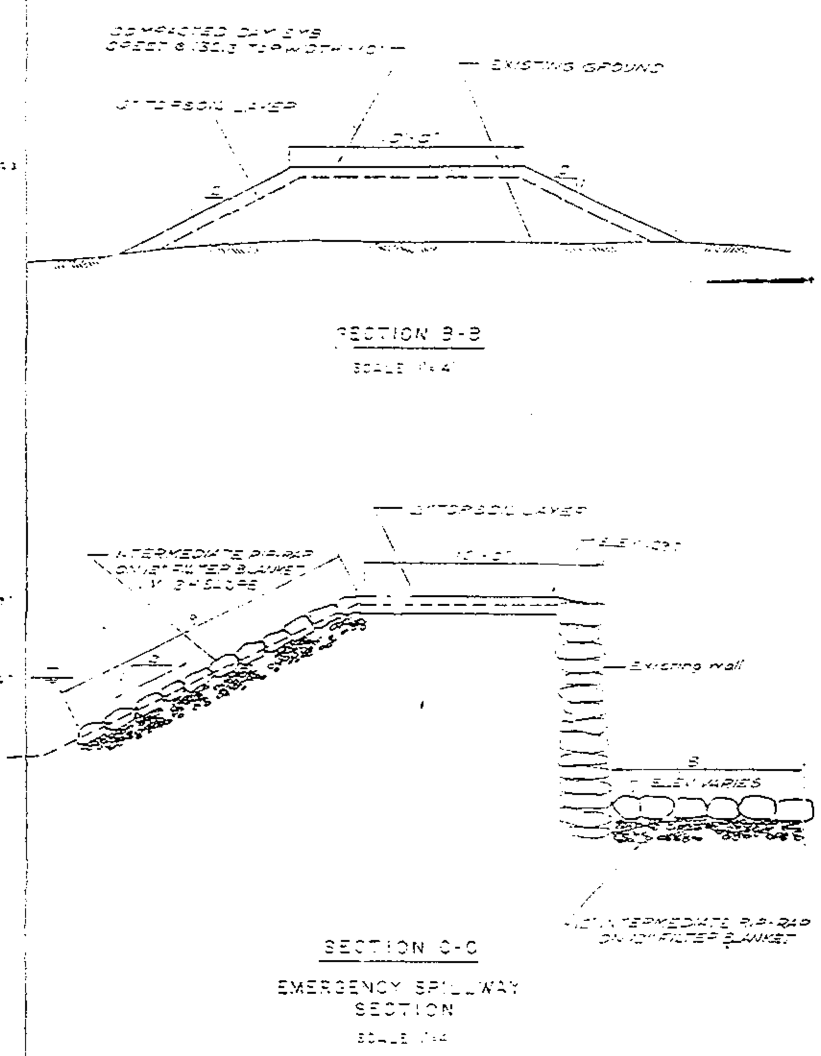
3. AUXILIARY SPILLWAY #2 IS LOCATED APPROXIMATELY 500' SOUTHWEST OF AUXILIARY SPILLWAY #1 AND IS NOT INCLUDED IN THE PLAN.

Messerschmidt Pond Dam
Westbrook, Connecticut

PLAN AND PROFILE

PLATE 2





THIS DRAWING HAS BEEN REDUCED TO 1/2 SIZE.

Wrights Pond Dam
Westbrook, Connecticut

PLAN AND PROFILE

PLATE 3

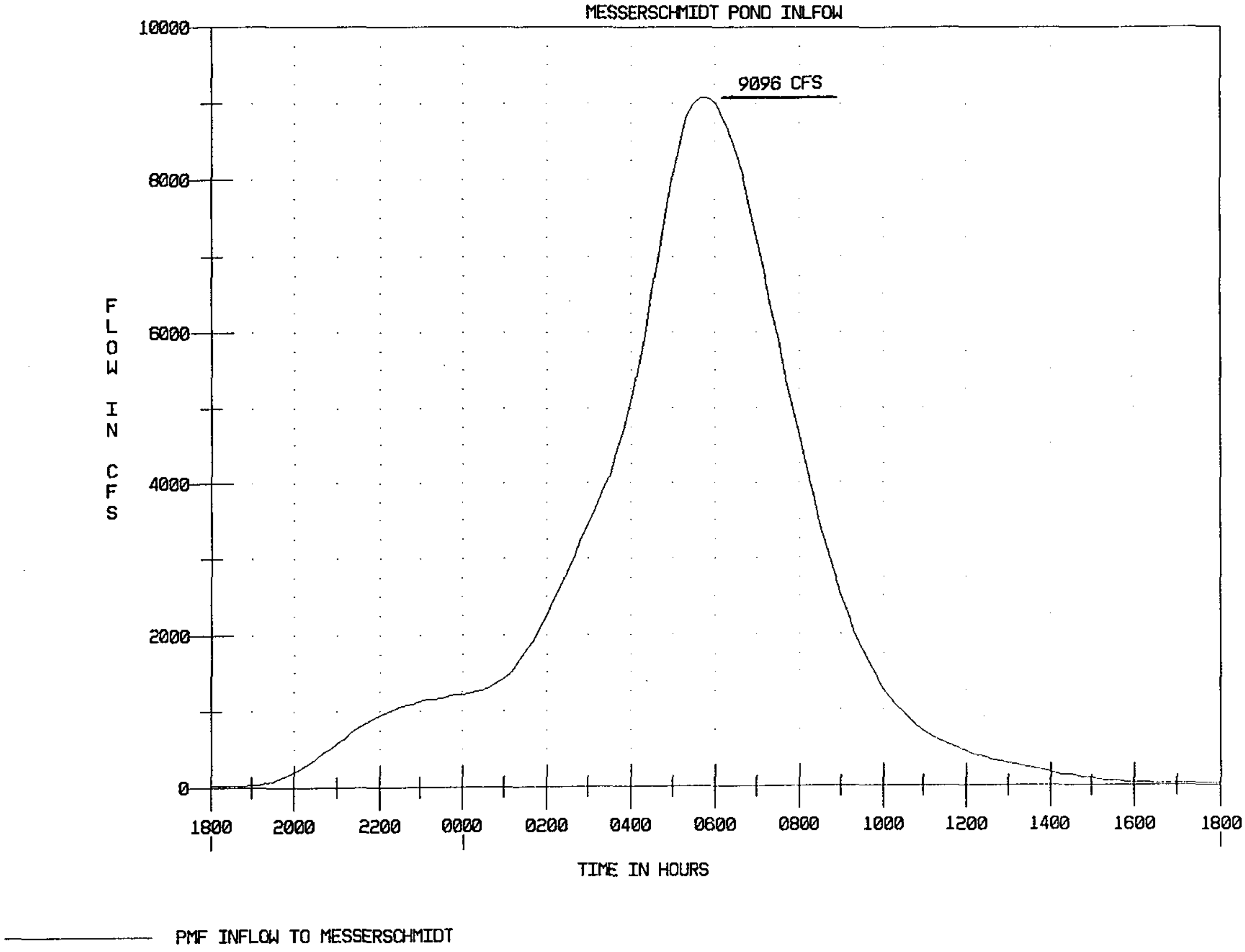

MESSERSCHMIDT POND INLFOW
9096 CFS
FLOW IN CFS
10000
8000
6000
4000
2000
0
1800
2000
2200
0000
0200
0400
0600
0800
1000
1200
1400
1600
1800
TIME IN HOURS
PMF INFLOW TO MESSERSCHMIDT

PLATE 4

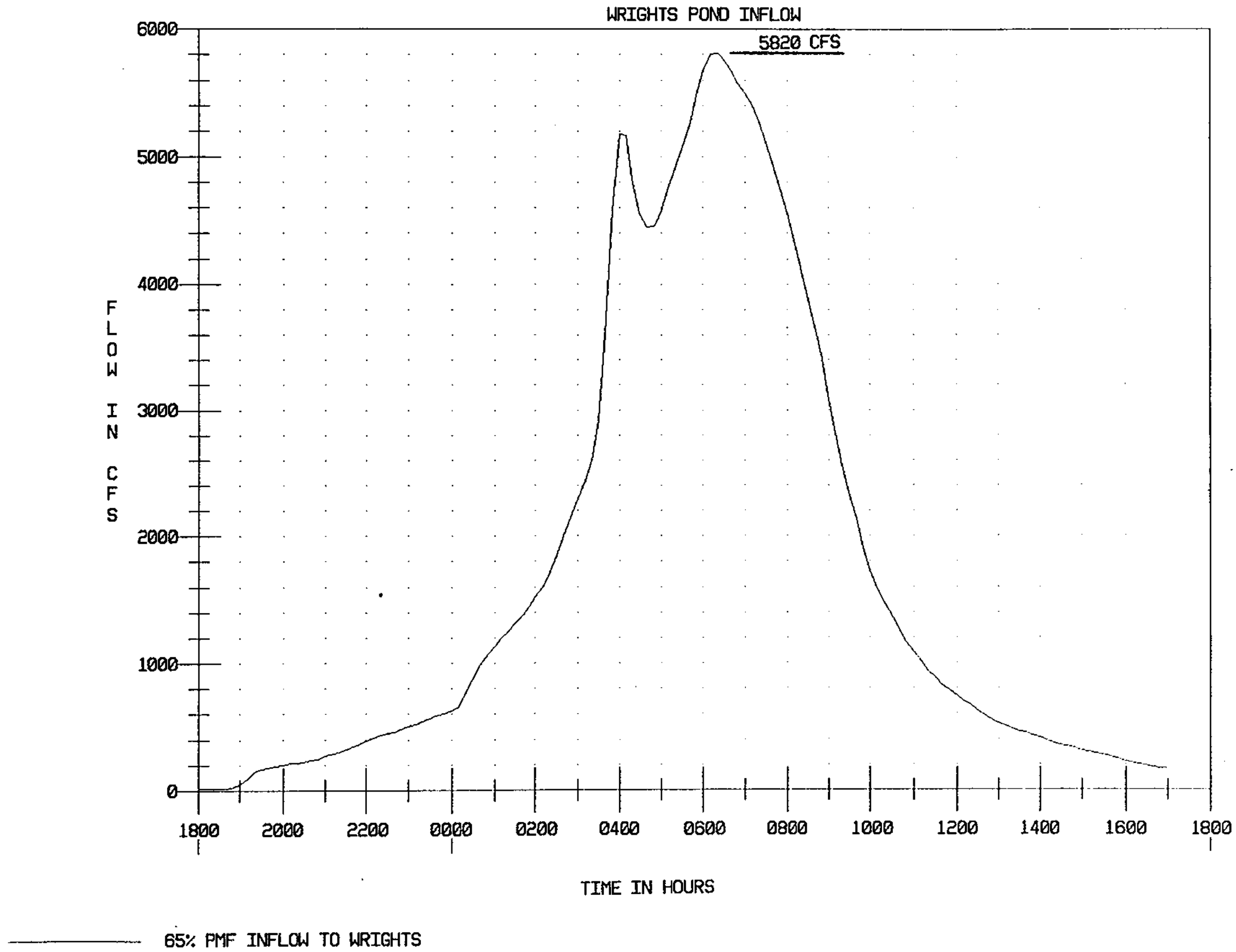
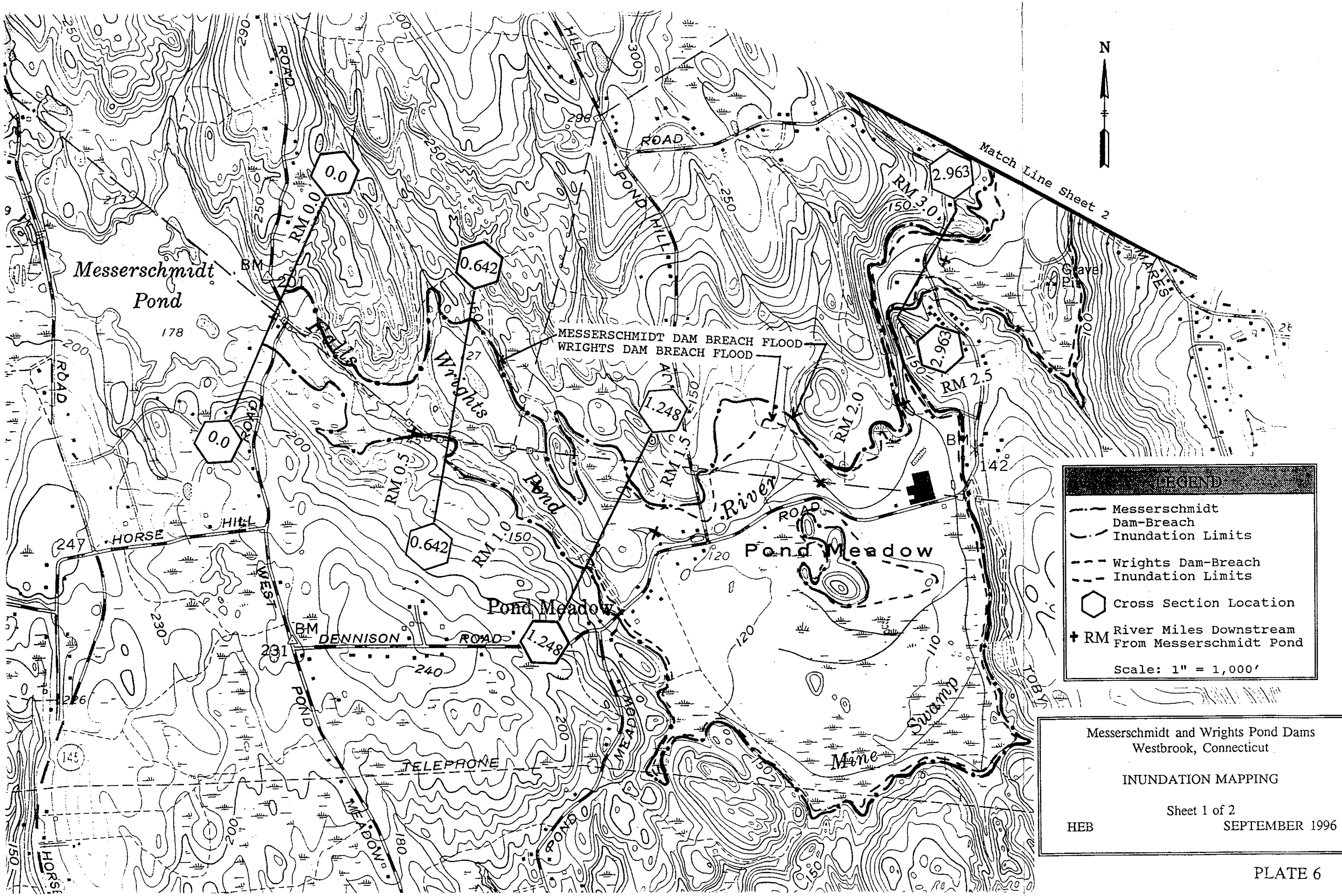

WRIGHTS POND INFLOW
5820 CFS
6000
5000
4000
3000
2000
1000
0
FLOW IN CFS
1800
2000
2200
0000
0200
0400
0600
0800
1000
1200
1400
1600
1800
TIME IN HOURS
65% PMF INFLOW TO WRIGHTS

PLATE 5



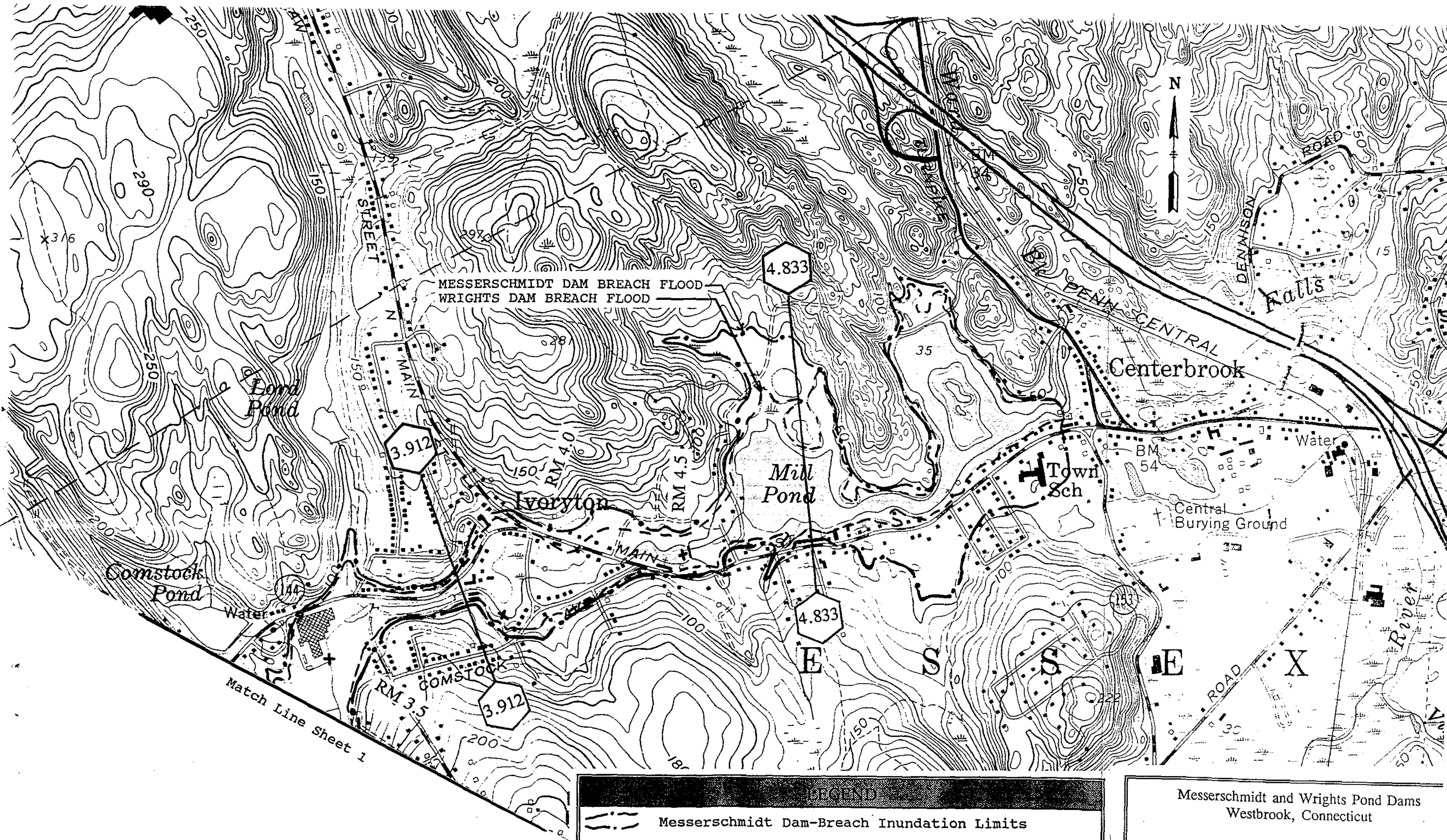
Messerschmidt and Wrights Pond Dams
Westbrook, Connecticut

INUNDATION MAPPING

Sheet 1 of 2

HEB SEPTEMBER 1996

PLATE 6



LEGEND

Messerschmidt Dam-Breach Inundation Limits

Wrights Dam-Breach Inundation Limits

Cross Section Location

RM River Miles Downstream From Messerschmidt Pond

Scale: 1" = 1,000'

Messerschmidt and Wrights Pond Dams
Westbrook, Connecticut

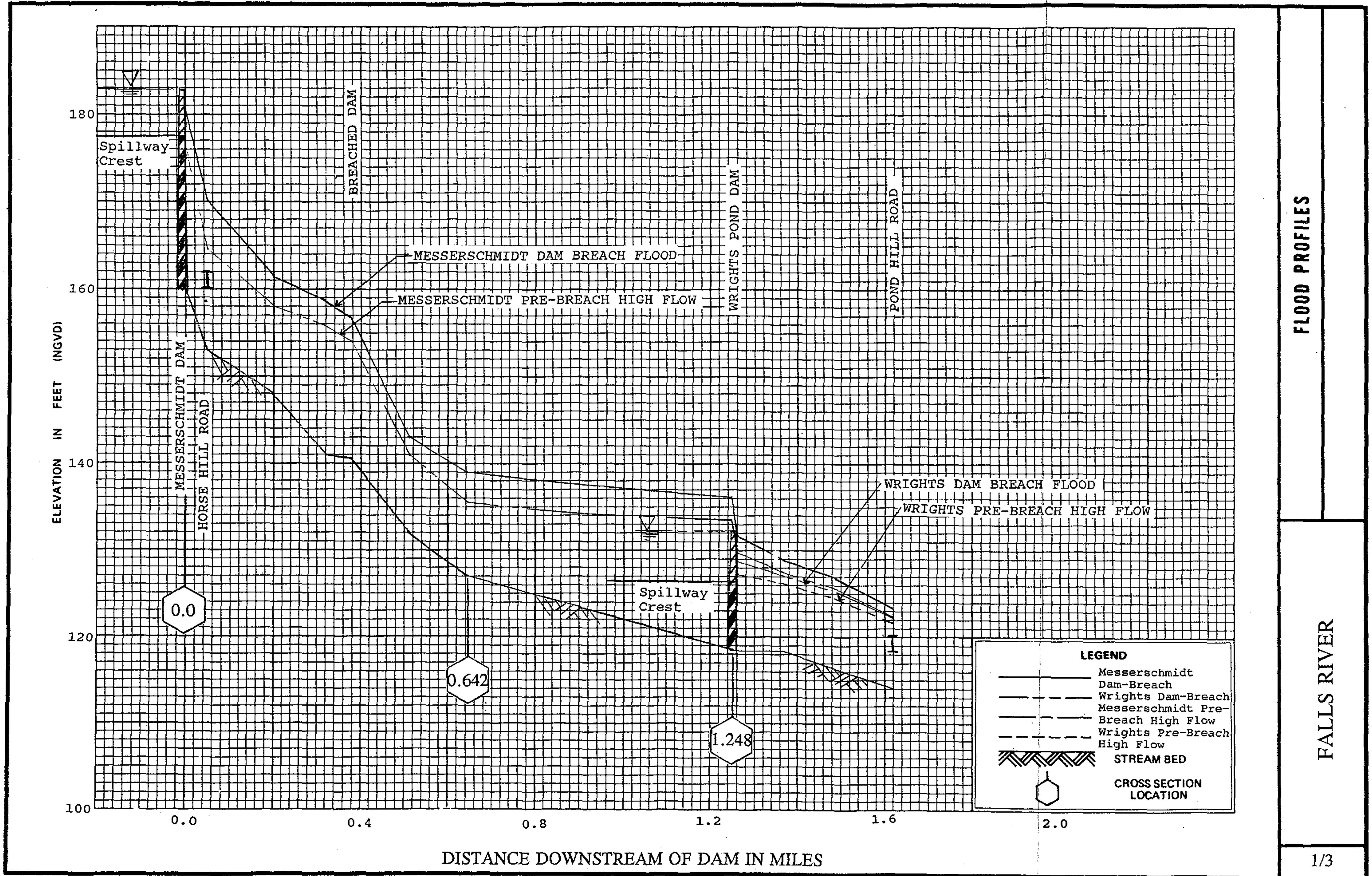
INUNDATION MAPPING

Sheet 2 of 2

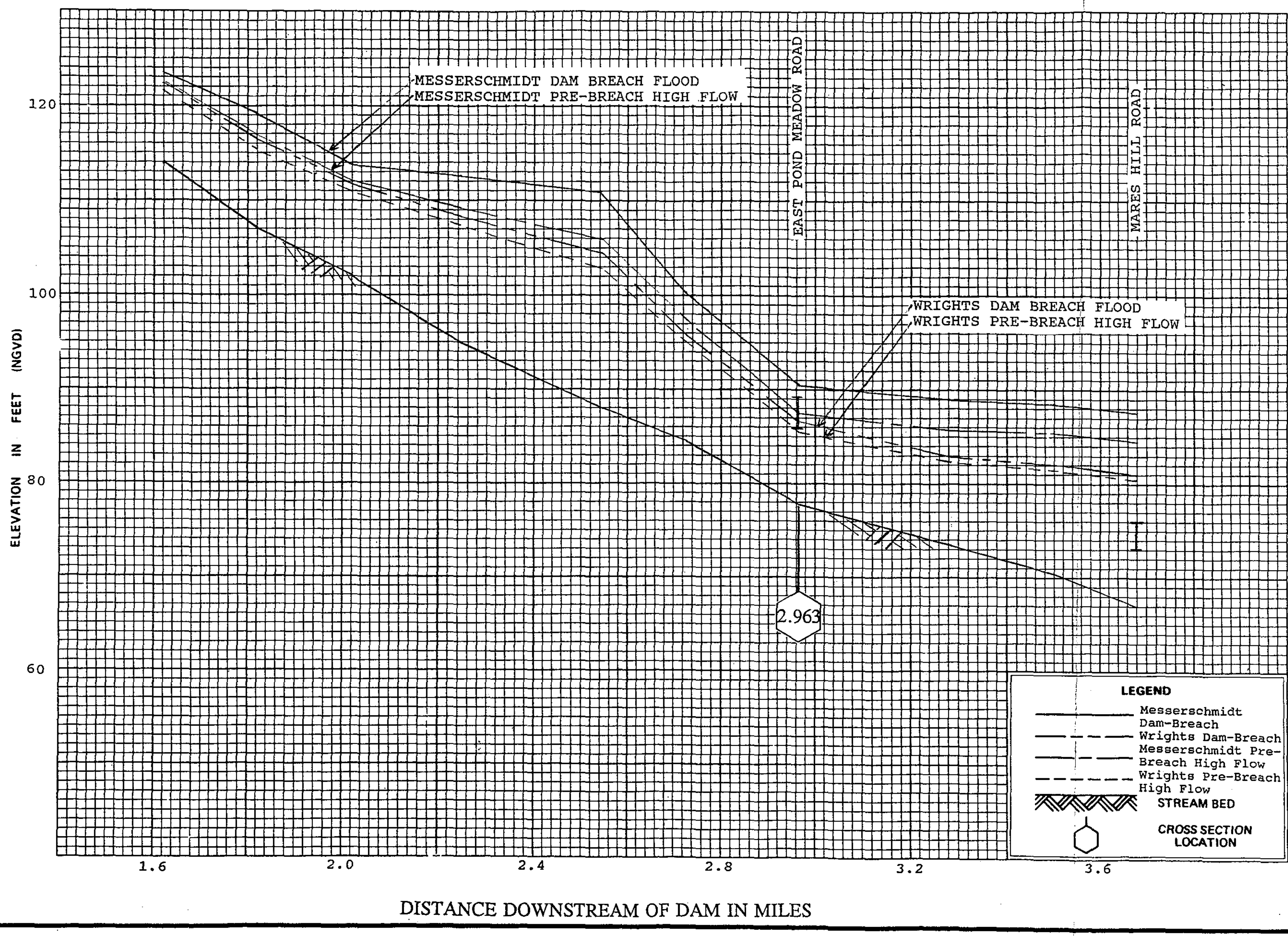
HEB

SEPTEMBER 1996

PLATE 7



FLOOD PROFILES
FALLS RIVER
1/3
ELEVATION IN FEET (NGVD)
DISTANCE DOWNSTREAM OF DAM IN MILES
180
160
140
120
100
0.0
0.4
0.8
1.2
1.6
2.0
Spillway Crest
BREACHED DAM
MESSERSCHMIDT DAM BREACH FLOOD
MESSERSCHMIDT PRE-BREACH HIGH FLOW
WRIGHTS POND DAM
POND HILL ROAD
MESSERSCHMIDT DAM
HORSE HILL ROAD
WRIGHTS DAM BREACH FLOOD
WRIGHTS PRE-BREACH HIGH FLOW
Spillway Crest
0.0
0.642
1.248
LEGEND
Messerschmidt Dam-Breach
Wrights Dam-Breach
Messerschmidt Pre-Breach High Flow
Wrights Pre-Breach High Flow
STREAM BED
CROSS SECTION LOCATION

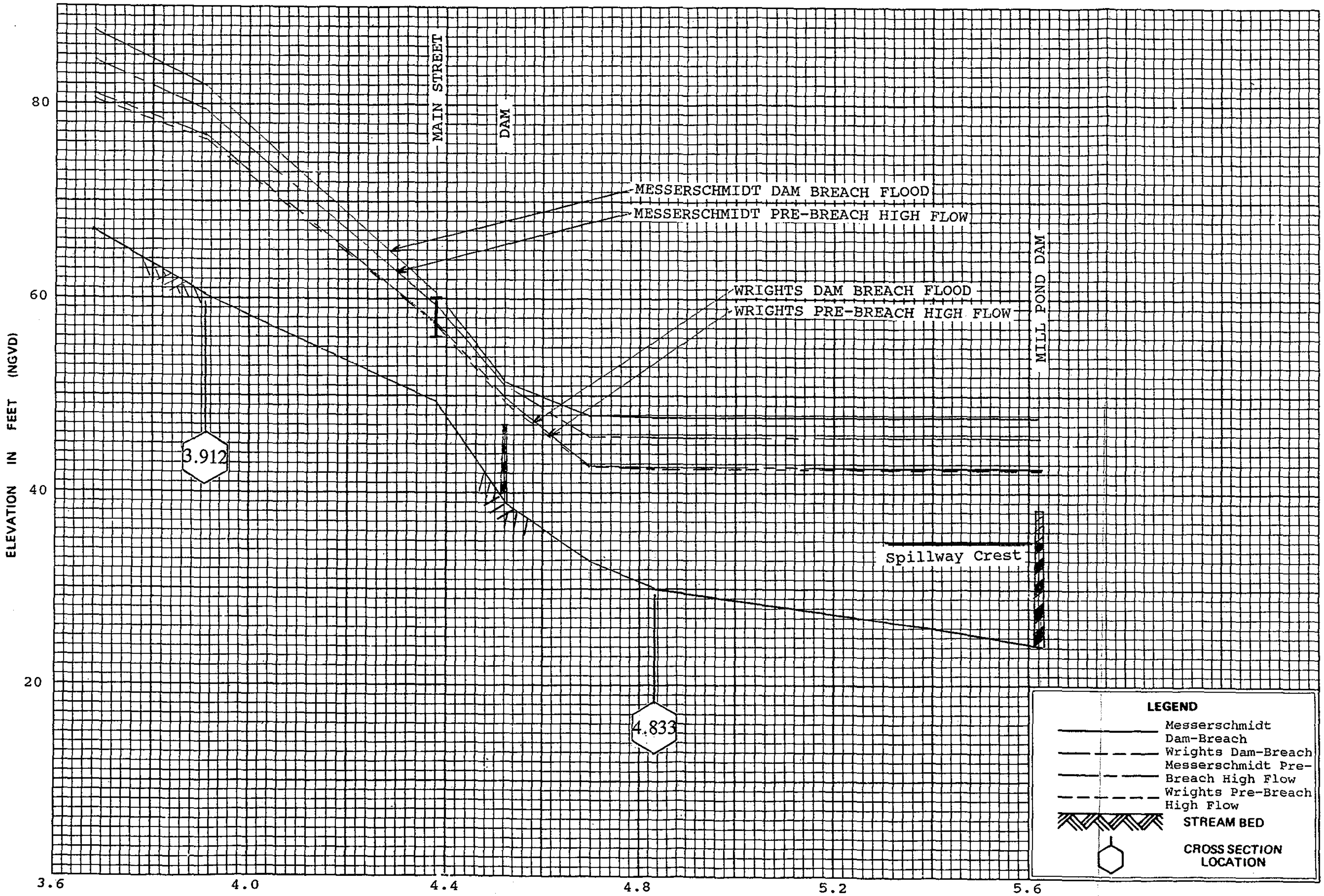


FLOOD PROFILES

FALLS RIVER

2/3

PLATE 9



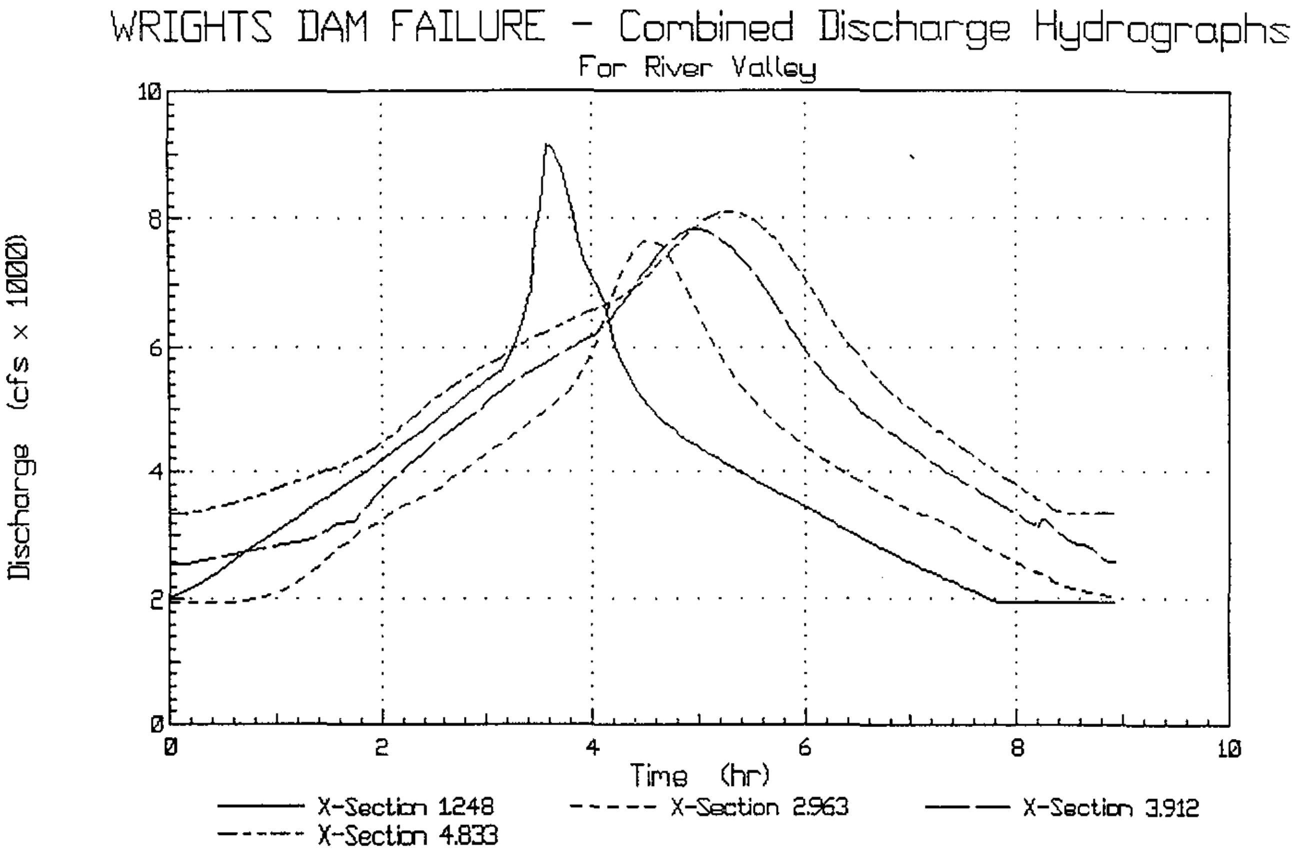
DISTANCE DOWNSTREAM OF DAM IN MILES

FLOOD PROFILES

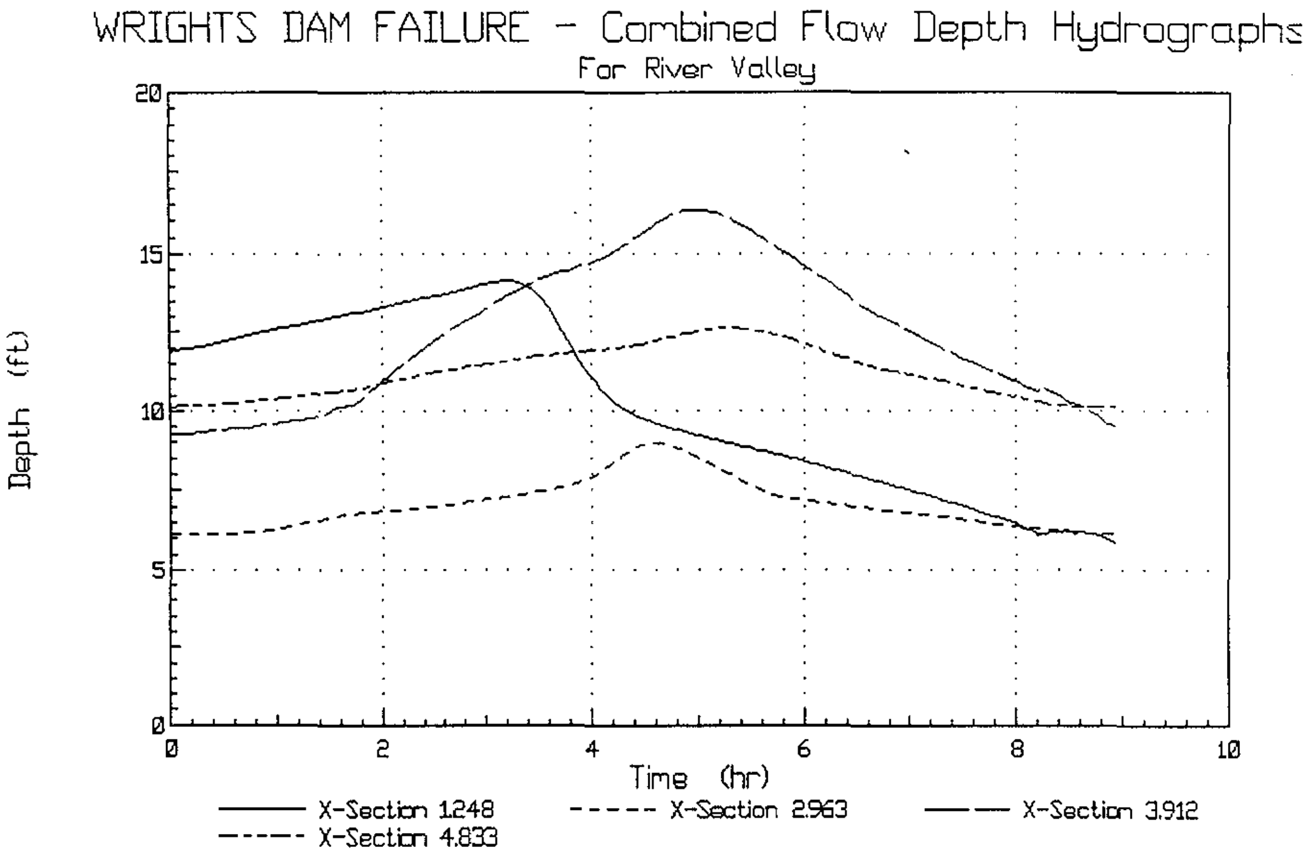
FALLS RIVER

3/3

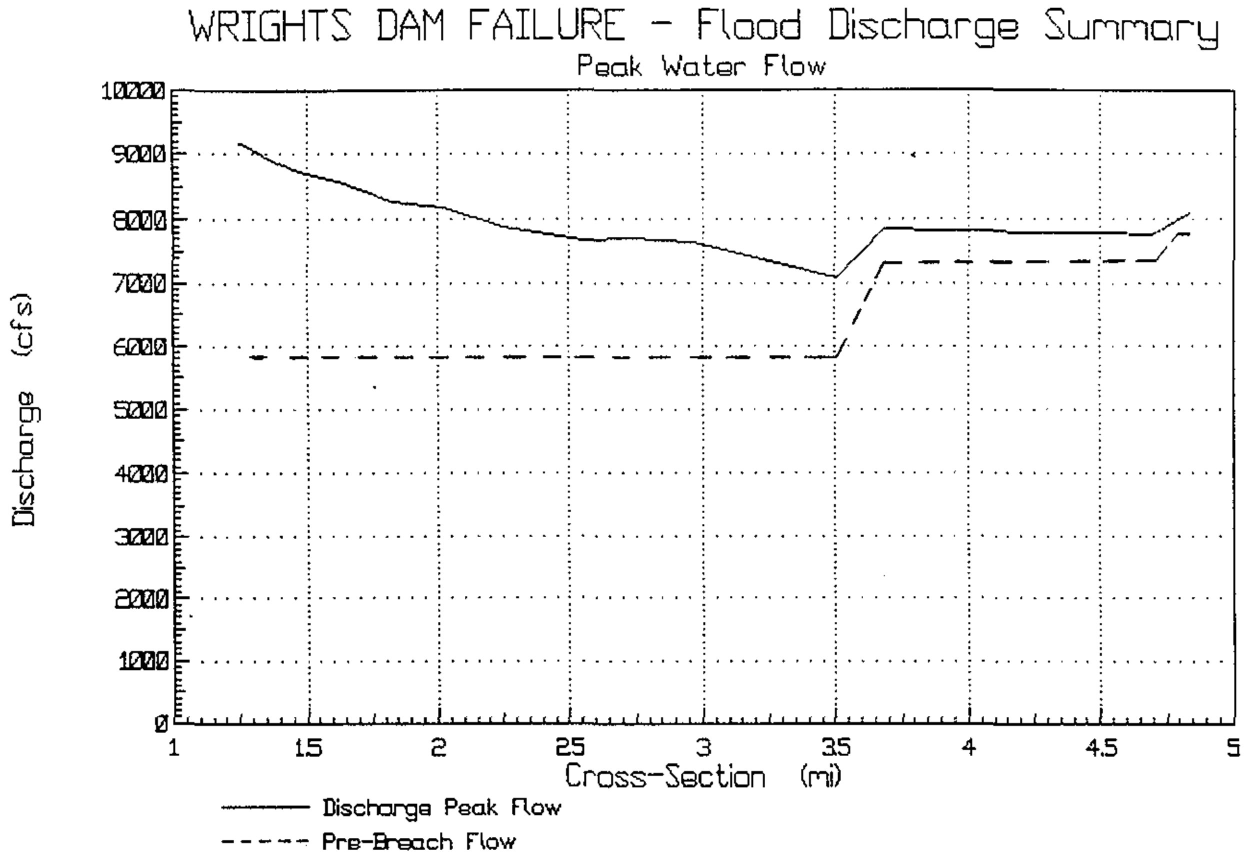
PLATE 10



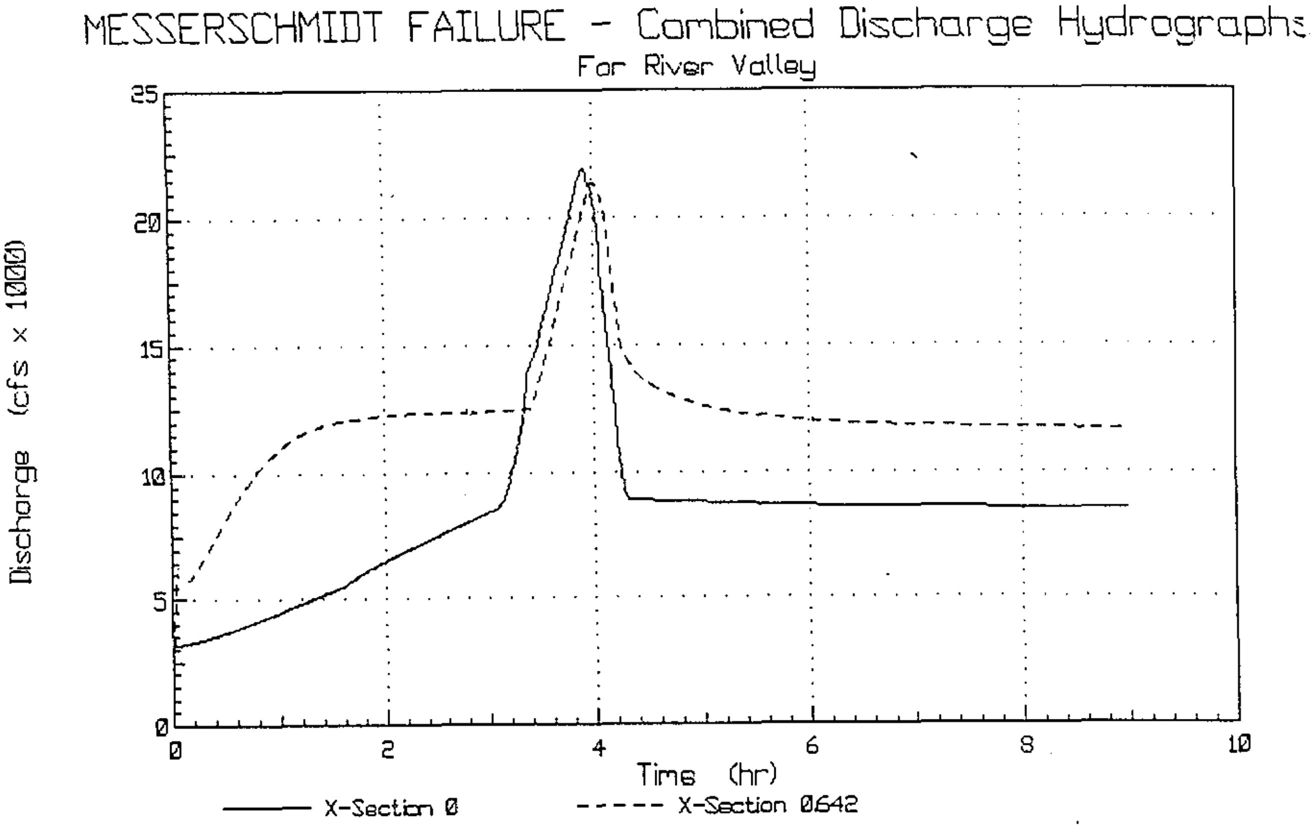
Note: Start of failure at hour 3

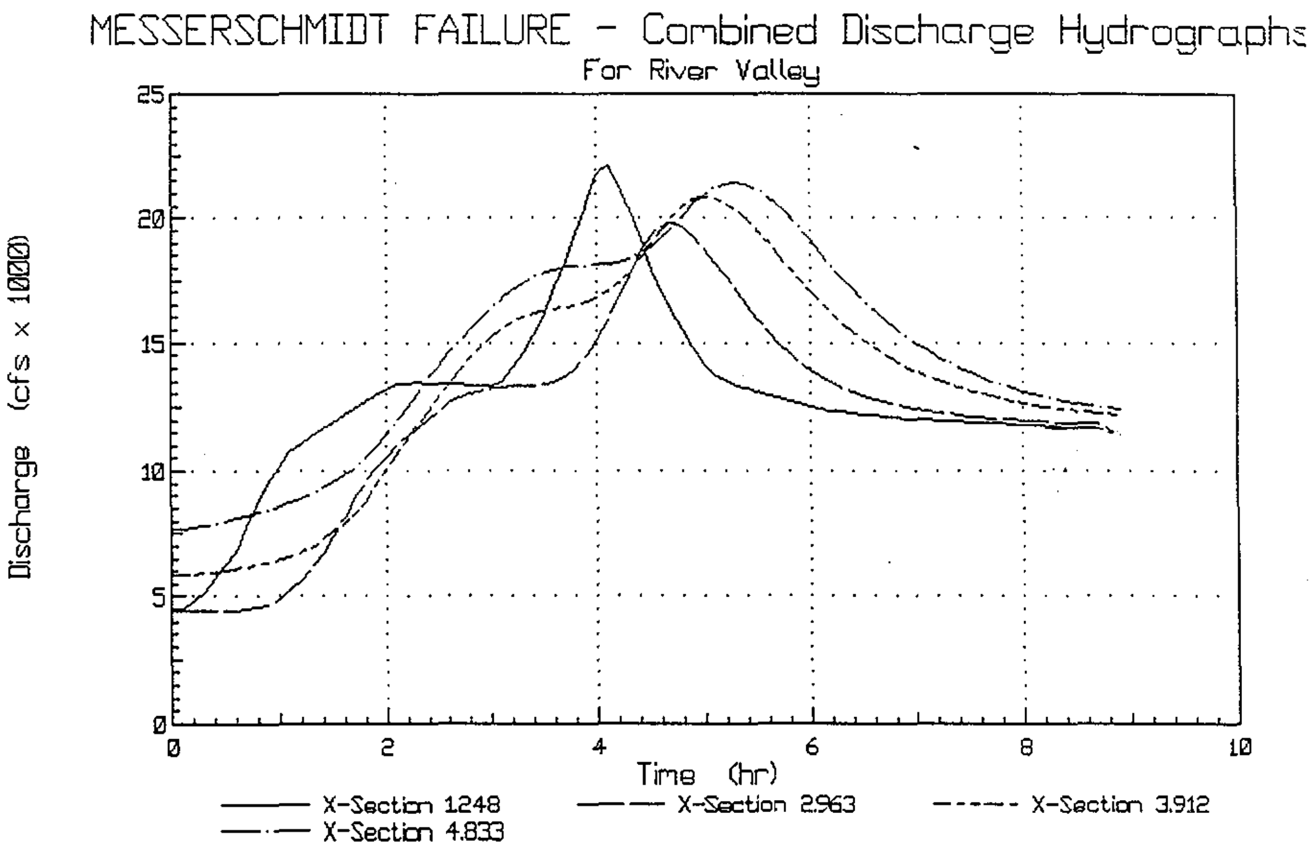


Note: Start of failure at hour 3

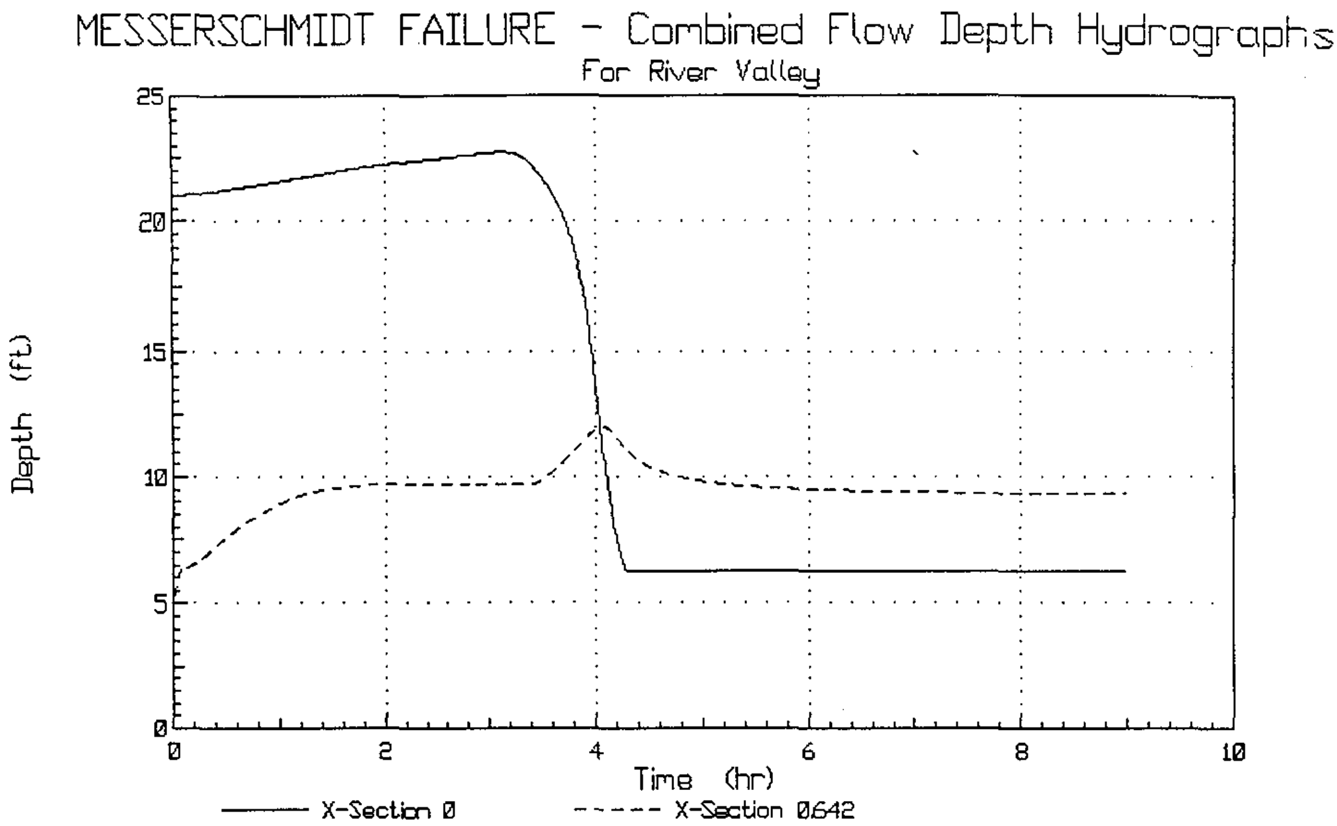


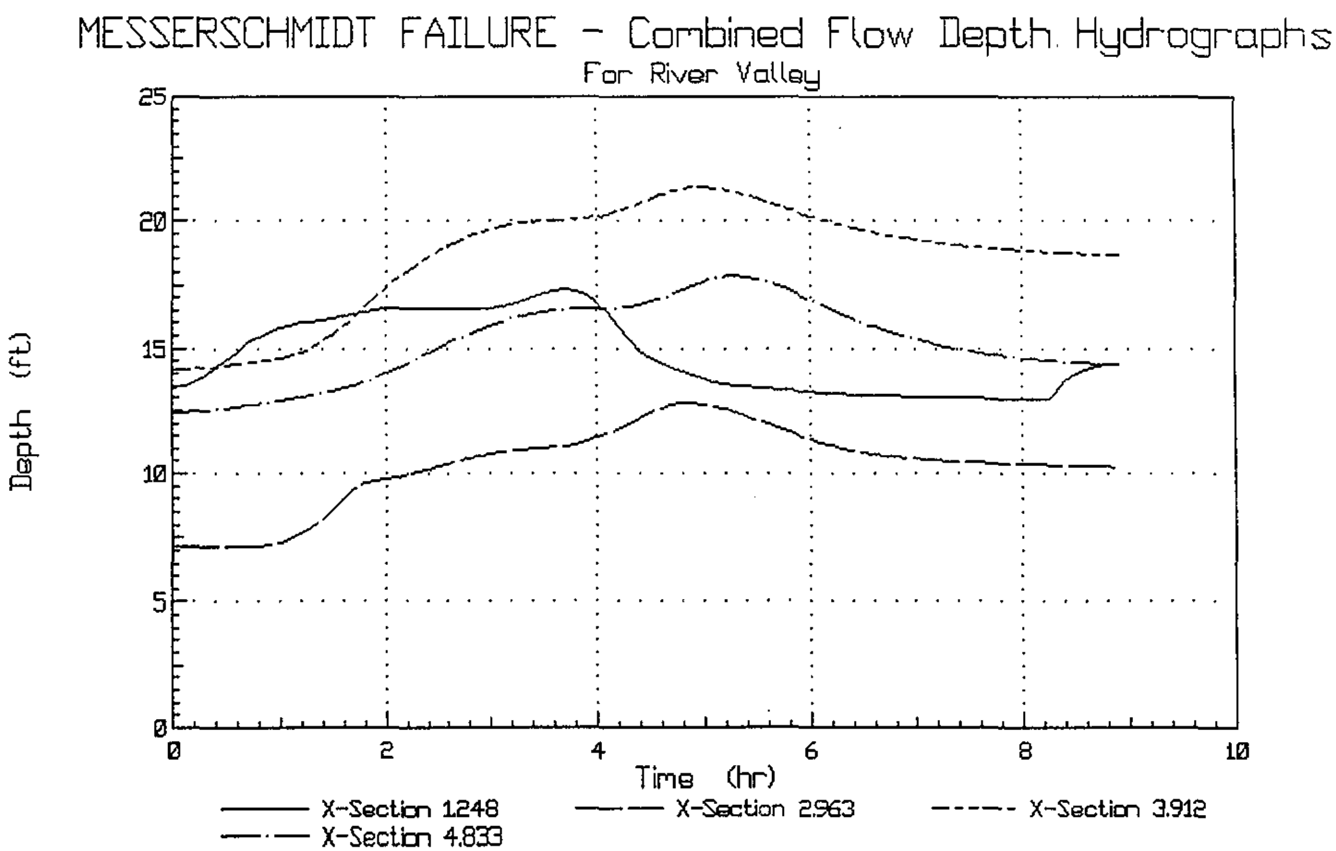
WRIGHTS DAM FAILURE - Flood Discharge Summary
Peak Water Flow
Discharge (cfs)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1
1.5
2
2.5
3
3.5
4
4.5
5
Cross-Section (mi)
Discharge Peak Flow
Pre-Breach Flow



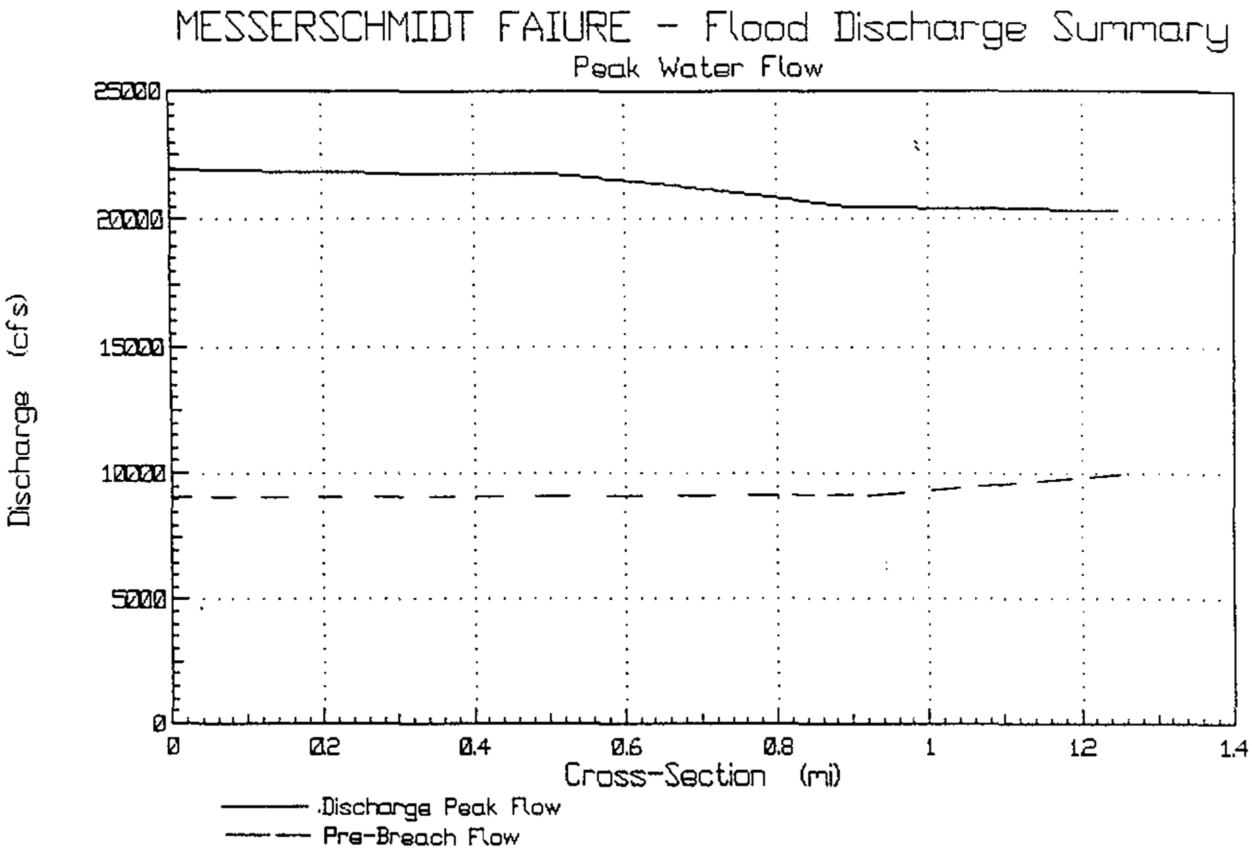


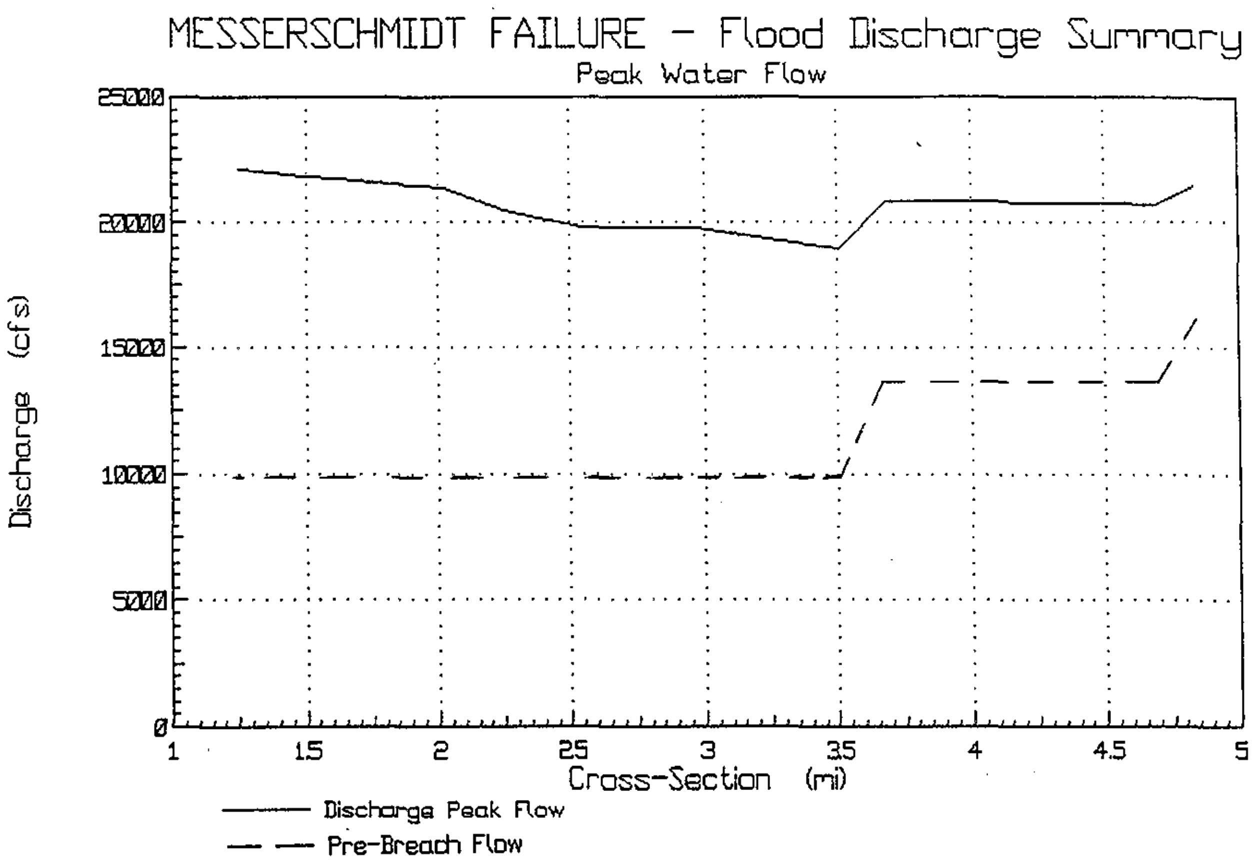
Note: Start of failure at hour 3





Note: Start of failure at hour 3


MESSERSCHMIDT FAIURE - Flood Discharge Summary
Peak Water Flow
Discharge (cfs)
25000
20000
15000
10000
5000
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
Cross-Section (mi)
Discharge Peak Flow
Pre-Breach Flow


MESSERSCHMIDT FAILURE - Flood Discharge Summary
Peak Water Flow
Discharge (cfs)
25000
20000
15000
10000
5000
0
1
1.5
2
2.5
3
3.5
4
4.5
5
Cross-Section (mi)
Discharge Peak Flow
Pre-Breach Flow